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VOL. 29. Ser. A. Part 6. pp. 281–328. JUNE, 1941.

THE REVIEW OF APPLIED ENTOMOLOGY.

SERIES A: AGRICULTURAL.

ISSUED BY THE IMPERIAL INSTITUTE OF ENTOMOLOGY.

LONDON:
THE IMPERIAL INSTITUTE OF ENTOMOLOGY,
41, QUEEN'S GATE, S.W.7.

Price 3s. net.

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IMPERIAL INSTITUTE OF ENTOMOLOGY

FARNHAM HOUSE LABORATORY

The war has reduced the opportunities for work based on Farnham House. Dr. Thompson, the Superintendent of the Laboratory, is now stationed at the Dominion Parasite Laboratory, Belleville, Ontario, Canada, where the Canadian Government has provided quarters and facilities for his work and that of his staff on the biological control of insect and plant pests. His senior assistant, Mr. E. Cameron, remains in the United Kingdom available for such work as can be done in that country.

Work on the natural enemies of animal and plant pests can now be undertaken in the temperate, subtropical and tropical regions of the Western Hemisphere. Entomologists in the countries of the British Commonwealth of Nations who wish to avail themselves of this opportunity for an extension of their biological control work are asked to communicate with Dr. W. R. Thompson, F.R.S., Imperial Parasite Service, Imperial Institute of Entomology, 228, Dundas Street, Belleville, Ontario, Canada, giving a detailed statement of their requirements.

Those who require parasites normally obtainable in the United Kingdom are asked to send their requests with similar details to The Director, Imperial Institute of Entomology, British Museum (Natural History), Cromwell Road, London, S.W.7, England.

Such division of orders should save time, but the parasites required will be obtained from whichever source is the more convenient or more promising. Dr. Thompson remains as Superintendent and in general charge.

MONTGOMERY (H. B. S.), MOORE (M. H.), SHAW (H.) & STEER (W.). **Insecticides and Fungicides.**—*Rep. E. Malling Res. Sta. 1939* **27** pp. 32–34. East Malling, 1940.

Work on insecticides for use against pests of fruit trees and bush fruits in south-eastern England is briefly reviewed. In a study of the ovicidal properties of tar distillates, the neutral portions of a series of aromatic and non-aromatic oils derived from them were isolated and fractionated according to boiling range, and an attempt made to correlate the chemical and physical properties of these fractions with ovicidal properties. The content of high-boiling neutral oil soluble in dimethyl sulphate is a satisfactory criterion of toxicity to eggs of *Aphis pomi*, DeG., only in the case of horizontal retort and coke-oven tar distillates. Low-temperature tar oils and certain tar hydrogenation products show a wide divergence. Boiling range is a principal, but not the sole, factor determining toxicity to eggs of *Operophtera brumata*, L. ; viscosity is also of major importance. Investigations on the physiology of ovicidal action established that many ovicides do not inhibit the development of the embryo, even if applied at doses that prevent hatching. The susceptibility of eggs of *A. pomi* to nicotine is correlated with post-diapause development.

When mixed with lime-sulphur, calcium arsenate has proved more injurious to fruit trees than lead arsenate ; the addition of ferrous sulphate to either mixture reduced leaf-drop but not fruit-drop. In sprays containing lime-sulphur and lead arsenate, the amount of soluble arsenic liberated from a given amount of lead arsenate decreased as the concentration of lime-sulphur increased between 0·5 and 2·0 per cent.

A second generation of *Cydia pomonella*, L., occurs only in some seasons in south-eastern England, and is relatively unimportant ; the main generation can be controlled by the use of lead arsenate in late June. In this connection, experiments have shown that the effect of wetting and spreading agents or of lime-sulphur on the deposition and retention of lead arsenate on apples is negligible, but that the addition of 1 per cent. refined petroleum oil increases deposit [*cf. R.A.E.*, A **28** 102]. In tests with atomised pyrethrum sprays, adults of the raspberry beetle, *Byturus tomentosus*, F., were affected but generally recovered. Nymphs of the apple Capsid, *Plesiocoris rugicollis*, Fall., were destroyed by contact with the droplets, but as the nymphs are never all freely exposed, several applications are necessary and the cost compares unfavourably with that of dormant spraying for Capsid control. During observations on apple trees that had or had not received dormant sprays, some evidence was obtained that adults of *Paratetranychus pilosus*, C. & F. (*Oligonychus ulmi*, auct.) are spread from tree to tree by wind and so give rise to the late attacks that are often observed even on trees that have been well sprayed with a winter petroleum. In an attempt to discover a post-blossom spray to use instead of the pre-blossom spray generally employed against *Eriophyes ribis*, Nal., on black currant, concentrations of lime-sulphur as low as 1 per cent. were found to cause severe injury. A post-blossom spray of derris and soap caused no injury but was less effective than a pre-blossom application of 2 per cent. lime-sulphur.

(979) Wt P14/3703 1700 6/41 S.E.R. Ltd. **Gp. 432.** [A] A

WORMALD (H.). **The Angular Leaf Spot of Apple Trees.**—*Rep. E. Malling Res. Sta. 1939* **27** pp. 63–66, 1 fig., 6 refs. East Malling, 1940.

In an appendix to this paper on angular leaf spot of apple, the fungi associated with it and its distribution in England in 1937–39, it is stated that leaf-spots differing only in colour (reddish-brown or dark brown instead of yellowish or silvery grey) were observed on apple and pear in late May 1940 and apple in early June in two localities in Kent. They were associated with severe infestation by *Tomaspis* (*Cercopis*) *sanguinea*, Geoffr. (*Triecphora vulnerata*, Ill.). A. M. Massee and W. Steer, who were the first to observe them, have proved experimentally that the Cercopid is the primary cause of these spots, and investigations are in progress to determine whether any fungus is associated with them.

MASSEE (A. M.). **Notes on some interesting Insects observed in 1939.**—*Rep. E. Malling Res. Sta. 1939* **27** pp. 70–73, 1 ref. East Malling, 1940.

Insects observed in south-eastern England during 1939 included *Stethorus* (*Scymnus*) *punctillum*, Weise, which in summer is not uncommon in hop gardens, where the larvae are predacious on the hop-damson aphis [*Phorodon humuli*, Schr.] and other insects and mites associated with hops. *Orius* (*Triphleps*) *laevigatus*, Fieb., an Anthocorid not previously recorded in Britain, was predacious on *P. humuli* in one hop garden, but was not numerous enough to be of much value. Severe damage to the roots of hops by larvae of *Agriotes lineatus*, L., and possibly other wireworms, was reported from three districts, in one of which the young vines began to wilt in the second week of May. Satisfactory control was given by crude commercial naphthalene applied at the rate of 4 cwt. per acre round the hills only and lightly forked in.

Curculio (*Balaninus*) *nucum*, L., became unusually abundant in a plantation of cob nuts [*Corylus*] in 1937 and has steadily increased in numbers since ; in 1938, about 75 per cent. of the crop was infested by September. Larvae kept in the laboratory in a tin containing damp sand gave rise to adults at the beginning of February, but adults do not appear in the field until April. The apparent increase in numbers of this weevil is probably due to the destruction of many plantations in the neighbourhood and its subsequent migration to the remaining ones. Wild hazel is also attacked.

Larvae of the Geometrid, *Campaea margaritata*, L. (*Metrocampa margaritaria*, L.), were common in March in an apple orchard, where they damaged the young growth. They are known to feed on the foliage of apple and other fruit trees from September until leaf-fall, when they migrate to the young shoots and feed on the outer layers of the bark ; they are full-fed by the middle of May, and the adults occur in June and July. The injury resembles that caused by the clay coloured weevil [*Otiorrhynchus singularis*, L.], for which it is often mistaken. The larvae are seldom abundant enough to damage established trees, but sometimes cause trouble in the nursery.

Anuraphis crataegi, Kalt., caused serious damage to apple, and particularly to one variety, on two farms on which it had become more abundant than usual in 1938. It increases rapidly in numbers during

May and June, and injury is confined to this period. The edges of the leaves curl and become bright red or yellow and red. The alates appear in the third week of June but do not migrate, and clusters of eggs are deposited in cracks and under loose bark on the trunks and main branches of the apple trees in July.

Larvae of *Argyroploce urticana*, Hb., which normally feed on whortleberry [*Vaccinium*], honeysuckle, birch, etc., occur commonly on strawberry in two districts during May. This species is widespread and occurs only occasionally on strawberry, but causes considerable damage to the leaf stalks and flower trusses. Derris dust is effective if applied promptly.

Injury to strawberry by *Tarsonemus pallidus*, Banks, was locally severe in 1938 and 1939, particularly in three districts, but was confined to the Royal Sovereign variety. Populations of *Capitophorus fragariae*, Theo., were, in general, below normal in most districts, but exhibited considerable variation. *Macrosiphum solanifolii*, Ashm. (*gei*, auct.) occurs in small numbers in most strawberry fields but is of no economic importance on strawberry. Tipulid larvae were injurious to strawberry plants, particularly in one district in the south and two in the west. Attack was mainly confined to the crowns of young plants, as a result of which they were frequently destroyed ; plants newly set in spring are particularly susceptible. Prompt applications of a bait of Paris green and bran are effective ; they should be made before or after light rain at the end of April. One application early in May gave excellent control in two districts.

Incurvaria (*Lampronia*) *rubiella*, Bjerk., which is an important pest of raspberry, attacking the young shoots of the laterals, has in recent years been observed on wild and cultivated blackberry, and heavy infestations occurred on loganberry in two districts. The larvae appeared at the end of April, and on some plants the growths on 20 per cent. of the young laterals were wilted. Infestation was most severe towards the tips of the shoots. In September, raspberry canes in which the rind had split as a result of attack by cane blight caused by the fungus, *Leptosphaeria coniothyrium*, were found to be infested by *Thomasiniana theobaldi*, Barnes. The larvae of this Cecidomyiid occur beneath the rind and, when very numerous, cause the canes to branch or to die as a result of the rind peeling off. Adults appear in May and June and again in July and August, and the presence of larvae in September confirms the occurrence of a second generation. Control measures comprise the destruction of badly infested canes before the larvae leave them to pupate in the soil ; hoeing round the canes may also be of value.

MASSEE (A. M.) & GREENSLADE (R. M.). **Dipping of Strawberry Runners before Planting.**—*Rep. E. Malling Res. Sta. 1939* **27** pp. 73–74, 1 ref. East Malling, 1940.

Occasional reports have been received of severe injury to strawberry plants treated against *Capitophorus fragariae*, Theo., by dipping them in solutions of soft soap and nicotine [*R.A.E.*, A **28** 101], and the injury has been ascribed to the soap. When one-year-old strawberry plants that had been raised under glass and so were sappy and tender were immersed for 10 seconds in solutions of commercial soft (potash) soap or of soap prepared from oleic acid and caustic soda, both

containing nicotine, no injury resulted from 0·8 per cent. soft soap, and no permanent injury from 1·6 per cent. soft soap or 0·8 per cent. soda soap, which were the highest concentrations tested.

HARDY (C. H.). **Experiments with Winter Washes containing Dinitro-o-Cresol.**—*Agriculture* **47** no. 2 pp. 129–134, 3 refs. London, 1940.

An account is given of experiments in south-eastern England in 1939 in which sprays of dinitro-ortho-cresol dissolved in petroleum oil were compared with separate applications of tar oil and petroleum oil, for the control of the overwintering eggs of pests of apple. Combined sprays of tar oil and petroleum oil tend to damage the buds, while separate applications of the two materials are expensive and often difficult to carry out owing to weather conditions. Laboratory tests showed that sprays of dinitro-o-cresol combined with petroleum oil (conforming to grade E specification as given in a paper already noticed [*R.A.E.*, A **23** 497]) could be expected to provide adequate control of eggs of Aphids, apple sucker [*Psylla mali*, Schm.], winter moth [*Operophtera brumata*, L.], red spider [*Paratetranychus pilosus*, C. & F.] and Capsids. In the field tests, the concentrations of tar oil (Grade A), petroleum oil and dinitro-o-cresol in the diluted emulsions were 3, 5·6 and 0·11 per cent., respectively. The petroleum-oil emulsions with and without dinitro-o-cresol were applied on the same date in any one trial to avoid the risk of the control of Capsids varying with the date of application. In the case of *Psylla mali* and *O. brumata*, there was no significant difference between any of the treatments and all gave satisfactory control; dinitro-o-cresol with petroleum gave slightly better control of Capsids than tar oil followed by petroleum. There was no infestation by Aphids at any of the trial centres. Inspection of the trees showed that lichens and algae were killed by the dinitro-o-cresol washes and that there was no injury to the trees when the sprays were applied before bud-burst.

MASSEE (A. M.). **The Occurrence of *Typhlocyba froggatti* Baker (Hemipt.) in Kent.**—*Ent. mon. Mag.* **76** no. 918 p. 257. London, 1940.

It has been assumed for the past few years that the leafhoppers most commonly found on apple in England are *Typhlocyba rosae*, L., and *T. debilis*, Dgl. In mid-Kent in the summer of 1940, however, both were scarce on apple, on which *T. froggatti*, Baker, was the predominant species. *T. froggatti* was also common on several varieties of plum, and it was apparently the only species present on quinces at East Malling. At the beginning of September it occurred in numbers on a hedge of hawthorn [*Crataegus*]. Its abundance seems to indicate that it has been associated with fruit trees in the district for many years without having been recognised. Reference is made to two previous records of its occurrence in Britain.

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH. **Beetles Injurious to Timber and Furniture.**—*For. Prod. Res. Bull.* no. 19, 36 pp., 17 pls., 13 figs., 24 refs. London, H.M.S.O., 1940. Price 1*s.* 6*d.*

This bulletin on beetles injurious to native and imported timber in Britain and measures for their control is based on a previous one by

J. W. Munro [*R.A.E.*, A **16** 183], the text of which has been revised and expanded by R. C. Fisher in consultation with him to include results of recent investigations and information obtained by the Entomological Section of the Forest Products Research Laboratory [*cf.* **28** 451, etc.].

STEINHAUS (E. A.). **The Microbiology of Insects with special Reference to the biologic Relationships between Bacteria and Insects.**—*Bact. Rev.* **4** no. 1 pp. 17–57, 1940. (Abstr. in *Rev. appl. Mycol.* **19** pt. 10 p. 593. Kew, 1940.)

This is a comprehensive review, followed by a ten-page bibliography, of outstanding contributions to various aspects of the microbiology of insects, including the fungal flora of the intestinal tract, yeasts and moulds as food and as enzyme-producing auxiliaries in the digestive process, and the nature, function and transmissibility of intracellular micro-organisms (mycetomata).

HEY (G. L.). **Fruit Tree Red Spider. Its Control by Spring and Summer Washes.**—*Fruitgrower* **89** no. 2318 pp. 488, 493–494. London, 1940.

During recent years, *Paratetranychus pilosus*, C. & F. (*Oligonychus ulmi*, auct.) has greatly increased in numbers and has become a serious pest of fruit trees in south-eastern England. Its life-history is briefly reviewed [*cf. R.A.E.*, A **29** 108]; the summer life-cycle may be completed in a fortnight and up to seven generations may be produced in a year. On apple, the lime-sulphur sprays normally used for scab control kill the active stages of the mite, but frequently fail to prevent infestation, chiefly because eggs, which are not affected by them, are present when they are applied. Only a few of the winter eggs have hatched at the pink-bud stage, and though most of them have usually done so at petal fall, some summer eggs may already have been laid then. Three weeks later, when the next spray is usually applied, mites from the latter will themselves have oviposited. Other reasons for the failure of lime-sulphur include its use at a concentration of less than 1 per cent. or its application in a way that does not thoroughly wet the lower surfaces of the leaves [*cf.* **29** 109]; the inclusion of a wetting agent in the spray is probably desirable. No advantage has been obtained by the use of 1 per cent. white oil in the sprays applied at petal-fall or three weeks later, since it also is not an efficient ovicide.

The author suggests that a wetting agent should be included in the lime-sulphur sprays applied at the green- or pink-bud stages (or both) and at petal-fall, and that the trees should be carefully examined so that the petal-fall spray can be applied when as many winter eggs as possible have hatched but before summer eggs have been laid. If, however, lead arsenate or derris is included in the spray for the control of the sawfly [*Hoplocampa testudinea*, Klug] it will have to be applied not later than 8 days after 80 per cent. of the petals have fallen. On varieties susceptible to sulphur injury, a carefully timed spray of derris extract in white oil should be applied at petal-fall. Trees on which appreciable numbers of mites are present ten days later should receive a fourth spray of lime-sulphur and a wetter, 1 per cent. white oil or preferably derris in white oil. The last spray is the one least likely to injure the trees as the oil is used at a concentration of 0·5 per cent. or less, the derris extractives being the main toxic agent. A fifth spray

should be applied if necessary after another ten days. If the supplementary spraying is omitted and infestation develops later in the season, a spray should be applied then, and, if appreciable numbers of eggs are present, a second application should be made ten days later.

Good commercial control of *P. pilosus* on plums can generally be obtained by a spray of 1 per cent. lime-sulphur with a wetting agent applied 10–14 days after 80 per cent. of the petals have fallen, but when eggs are numerous at the time of spraying, the application should be repeated 10–14 days later. Where the plum sawfly [*Hoplocampa flava*, L.] is also a pest, a spray of 2 lb. derris powder and 1 gal. white oil per 100 gals. should be applied when the "cots" are splitting [*cf.* **29** 109].

HEY (G. L.). **Fruit Tree Red Spider. Further Observations on the Pest and its Control.**—*Fruitgrower* **90** nos. 2335 & 2336 pp. 196, 200, 219–220. London, 1940.

An account is given of the seasonal development of *Paratetranychus pilosus*, C. & F. (*Oligonychus ulmi*, auct.) as observed in orchards in Essex, Sussex and Cambridgeshire from April to July 1940. The hatching period of the winter eggs was unusually late and prolonged, and the subsequent development of the mites was much more rapid than it has recently been found to be in south-western England [*R.A.E.*, A **29** 108]. The first winter eggs hatched on apples about 6th May, when two varieties (Cox's Orange Pippin and Worcester Pearmain) were in full bloom in Essex. Only 10–20 per cent. had hatched by 17th May, when these two varieties were at the petal-fall stage. The last date on which hatching of winter eggs was observed was 3rd June, after which 10–20 per cent. or more (80 per cent. in two orchards) remained unhatched on the trees. In some cases they retained their red colour and did not shrivel until July. The first summer eggs were observed in Sussex on 23rd May, but they were not numerous in Essex or Sussex until 3rd June. They hatched from 9th to 26th June. The resulting mites began to oviposit on 22nd June, and their eggs began to hatch during the first week of July. An appreciable number of summer eggs failed to develop in some orchards. On one Essex farm, a block of apples was sprayed on 17th May with lime-sulphur (1 : 138 plus spreader) at petal-fall only. Adjoining trees were similarly sprayed at petal-fall with lime-sulphur, and then given an application of derris in white oil on 31st May. Observations on 3rd and 23rd June showed a severe attack on the first block and very few mites on the second, but on 15th July, infestation on both blocks was very slight, although no further sprays had been applied.

On plums, hatching of winter eggs began about 2nd May and was last observed on 25th May. Summer eggs were present in Cambridgeshire on 22nd May, and large numbers had been deposited by 27th May. Hatching begun by 4th June and was almost complete by 14th.

Most growers in Essex and Sussex applied petal-fall sprays of lime-sulphur to apples between 15th and 24th May, and they were consequently advised to spray again about ten days later. Where the petal-fall spray only was applied, little control was obtained, as the majority of eggs had not hatched. In view of the development of the mite in 1940, previous recommendations for summer sprays [*cf.* preceding abstract] are amended. In such a year, spraying should be carried out at petal fall, 10–12 days later to kill mites previously present as winter

eggs, and again 3–4 weeks later to control those hatching from the summer eggs. The last application should be timed to coincide with the period when the majority of the eggs have hatched. In most cases in 1940, two efficient applications afforded adequate control, but in isolated instances even three applications did not, as correct timing was rendered impossible by overlapping of the various stages.

Growers who sprayed plums 10–14 days after petal-fall (about 15th–20th May on Czar plums in Cambridgeshire) were more fortunate in their timing, as the majority of the winter eggs had hatched and no summer eggs had been laid. Even so, sufficient eggs hatched in some orchards to build up an infestation later in the season. A further application, about 30th May, against the first-generation adults or between 14th and 18th June against mites hatching from the summer eggs would have been advantageous in such cases. Where winter washes [*cf. loc. cit.*] were applied at the proper time and at the right strength, such good control was achieved that spring applications were unnecessary.

Brief notes are given on several insects that were observed on the apple trees. Attack by woolly aphis [*Eriosoma lanigerum*, Hsm.] was less severe in Essex, and it is considered that this may have been partly due to the sprays of white oil and derris applied against *P. pilosus*. There is evidence that these sprays, even without nicotine, are effective against the Aphid, and it is possible that derris in combination with oil may be as effective as white oil and nicotine.

DICKER (G. H. L.). **On Rubus Aphides and Leaf-hoppers as possible Vectors of Raspberry Mosaic.**—*J. Pomol.* **18** no. 3 pp. 275–286, 13 refs. London, 1940.

Previous investigations on virus diseases of raspberries in the United States, where they have been shown to be transmitted by Aphids, and in Great Britain, where the vector has not been ascertained, are very briefly reviewed, and an abridged account is given of the biology of the Aphids found breeding on the foliage or canes of cultivated forms of *Rubus* at East Malling, Kent [*R.A.E.*, A **28** 581].

Observations for three years on the spread of mosaic at East Malling indicated that the vector must be an insect universally present in raspberry plantations; the only Aphids taken in every plantation inspected were *Amphorophora rubi*, Kalt., and *Aphis idaei*, van der Goot, and they may, therefore, be regarded as potential vectors. Unpublished records show that in raspberries of the Lloyd George variety, infection is slow and sporadic during the first 2–3 years after planting, after which a definite spread along the row becomes obvious, which suggests that the initial infection may be due to a winged insect, possibly the alate form of one of the Aphids, while the more rapid spread from plant to plant may be due to the movement of wingless individuals. Seven species of Jassids, a list of which is given, were bred from nymphs collected in August and September on raspberries and cultivated blackberries, but they are rare on raspberries until the summer is advancing and the adults are active. Field observations suggest that the distribution of mosaic is less sporadic than it would be if they were the vectors.

Experiments with Lloyd George raspberries in 1938–39, in which *Macrosiphum rubiellum*, Theo., *M. rubifolium*, Theo., *Amphorophora*

rubi, *Aphis idaei* and Jassids were tested as potential vectors, gave inconclusive results. Recent observations by R. V. Harris have shown, however, that Lloyd George is not a suitable variety for such trials, since it is a symptomless carrier of the more severe and widely distributed of two forms of raspberry mosaic segregated by him.

In conclusion, brief notes are given on other diseases of cultivated forms of *Rubus* that have been observed in England and are almost certainly of virus origin.

GRAY (E.). **The Willow Wood Wasp and Water-mark Disease of Willows.**—*Vet. J.* **96** no. 9 pp. 370–373. London, 1940.

Watermark disease of willows, which is caused by *Bacterium salicis* [*cf. R.A.E.*, A **20** 341], has recently become a serious problem to the cricket-bat industry of East Anglia, and in view of the fact that W. H. Goddard has repeatedly found the willow wood wasp [*Xiphydria prolongata*, Geoffr.] in and about diseased and healthy willows in Essex [*cf.* **27** 562], investigations were carried out in the summer of 1938 to determine whether the wasp was a vector of the bacterium.

Cultures were made of sap from a patch of diseased wood in a living willow and from eggs and the intestinal contents of larvae, pupae and a male adult, all taken from infected trees ; a brown slimy growth appeared in the cultures and later turned yellow, and small discrete colonies of bacilli were observed. When males and females from healthy trees were caged on a diseased branch, similar growths were obtained from the ovaries and intestinal contents of two females dissected after 4 days ; the other wasps were transferred several days later to an apparently healthy branch, on which they fed, and the females oviposited. The organism was again isolated from the coelomic fluid, the gut and crushed extracts of the ovaries of the females, which were dissected 4 days later, and from a single egg. It also appeared in a culture medium over which one of the males had crawled. No eggs were found in or beneath the bark of the healthy branch, but when the bark was stripped off and washed in distilled water, a similar growth resulted when the washings were cultured.

It was pointed out by W. J. Dowson, however, that the organism isolated grew more rapidly than *Bacterium salicis*, and that the original coloration of the colonies was brown instead of grey. He considered it to be a form closely allied to *B. salicis* and associated with it in watermarked wood. There is little doubt that it is transmitted through the egg, and the wasp is apparently a passive carrier.

IYRIBOZ (Nihat). **Incir Hastaliklari.** [Diseases of Figs.]—*Publ. Minist. Agric. Turk. Rep.* no. 489, 85 + iii pp., text ill., 13 refs. Smyrna, 1940.

IYRIBOZ (Nihat) & ILERI (Mesude). **Önemli Ekin Anbar Zararlari.** [Pests of stored Cereals.]—*Op. cit.* no. 483, 23 pp., 23 figs. 1940. **Çekirgeler.** [Locusts.]—*Op. cit.* no. 484, 32 pp., text ill. 1940.

About 60 pages of the first of these publications are devoted to insects and mites that attack figs, including the harvested and dried fruit, in Turkey and elsewhere. Information is given on the bionomics and control of the more important species, with notes on the natural enemies of some of them, particularly the Coccids. The second

contains short notes on the usual insect pests of stored cereals and their control, with a brief section on mites, while the third comprises an account of the bionomics, natural enemies and control of locusts in Turkey. The greater part of it is devoted to *Dociostaurus maroccanus*, Thnb., but *Calliptamus italicus*, L., is dealt with briefly. The suggested control measures include the use of poison baits, barriers and flame-throwers.

BEESON (C. F. C.) & CHATTERJEE (N. C.). **Possibilities of Control of Lantana** (*Lantana aculeata* **Linn.) by indigenous Insect Pests.**—*Indian For. Rec.* (N.S. Ent.) **6** no. 3 pp. 39–84, 1 ref. Delhi, 1940. Price 2*s*.

This paper consists of two parts, the first of which, by Beeson (pp. 41–49), includes a survey of the results of the introduction into various parts of the world of insects for the destruction of the noxious weed, *Lantana camara* (*aculeata*), and a discussion of the ecology of insects found on it in India. It is concluded that none of the latter is suitable for practical use in its control [*cf. R.A.E.*, A **8** 473], though during a survey in 1937 at Dehra Dun, over 400 insects were found visiting it. It is suggested that future work on its suppression in India should include the introduction of the Tingid, *Teleonemia scrupulosa*, Stål (*lantanae*, Dist.), which has given encouraging results in Queensland [*cf.* **28** 317], and research in tropical America with a view to discovering additional insect enemies or diseases in its country of origin.

The second part, by Chatterjee (pp. 50–84), deals with the biology of 54 species of insects found actually feeding on *L. camara* at Dehra Dun in 1936–37, and includes notes on their distribution and alternative food-plants. Most of them occur only in small numbers, but several of those that attack the leaves, flowers or fruits breed continuously on *Lantana*. They are, however, prevented from becoming abundant by diseases and parasites. The species discussed at some length are the Agromyzid, *Agromyza* (*Ophiomyia*) *lantanae*, Frogg., the Arctiids, *Creatonotus transiens*, Wlk., and *Diacrisia obliqua confusa*, Btlr., the Noctuids, *Heliothis* (*Chloridea*) *armigera*, Hb. (*obsoleta*, F.), *Hypena abyssinialis*, Gn. (*ignotalis*, Wlk.), *Plusia* (*Phytometra*) *chalcites*, Esp., and *Prodenia litura*, F., the Psychid, *Clania* (*Cryptothelea*) *crameri*, Westw., the Pterophorid, *Platyptilia pusillidactyla*, Wlk., and the mealybug, *Ferrisiana* (*Pseudococcus*) *virgata*, Ckll.

The larvae of the Agromyzid feed exclusively on the pulp of green and ripe fruits, and the embryos of the seeds are not destroyed [*cf.* **22** 595]. It produced 21 generations a year at Dehra Dun, but is parasitised by eight species of Chalcidoids. The two Arctiids occur in small numbers only, and the feeding of the larvae does not kill the plants, though it restricts seed production to some extent. Larvae of *H. armigera* are polyphagous and predacious on other larvae present in *Lantana* flowers. The larvae of *Hypena abyssinialis* and *Prodenia litura* are slow feeders and cause only a negligible amount of defoliation ; while those of *Plusia chalcites* are not abundant and are destroyed by *Heliothis armigera*. The Psychid and the Pterophorid also occur in small numbers, and the activity of the latter in checking the formation of *Lantana* seed is greatly reduced by *H. armigera*. Infestation by the mealybug does not appreciably affect the plants.

Tables are given showing the seasonal history of *L. camara* at Dehra Dun in 1936–37 and the parts of the plant attacked by each of the 54 insects recorded.

Notification, Agriculture no. F.193/40–A.—*Govt. India, Dep. Educ., Hlth & Lds.* 1 p. New Delhi, 3rd February 1941.

This Order under the Destructive Insects and Pests Act, 1914 [*R.A.E.*, A **2** 273] prohibits the importation into British India of living insects in any stage except under permit and unless certified by an Entomologist of the Government of the country of origin to be free from disease. Beneficial insects imported by specified institutions are exempt from this prohibition.

COMPERE (H.). **A new Species of** *Metaphycus* **(Hymenoptera, Encyrtidae) from Australia parasitic in** *Eriococcus coriaceus* **Maskell.**—*Trans. roy. Soc. S. Aust.* **64** pt. 1 pp. 46–47. Adelaide, 1940.

Descriptions are given of adults of both sexes of *Metaphycus memnonius*, sp. n., reared from *Eriococcus coriaceus*, Mask., on *Eucalyptus* at Adelaide, South Australia, in 1936.

Notes on the Cabbage White Butterfly.—*Vict. Nat.* **57** no. 5 pp. 96–97. Melbourne, 1940.

In the first of these two notes, R. W. Armitage states that *Pieris rapae*, L., became very abundant near Melbourne [*cf. R.A.E.*, A **28** 47] during the summer of 1939–40 and that adults were present as late as 3rd June and as early as 4th August in the following season. In the second note, G. M. Hyam states that *P. rapae* was not observed at any great distance from Melbourne until the first week in October 1939, but that it had reached the extreme eastern and western borders of Victoria by April 1940, and had penetrated into New South Wales. Surveys of market gardens near Melbourne showed that it caused no damage where efficient dusts containing derris or arsenates were employed against other cabbage pests, but ruined the whole crop if not effectively controlled. Larvae were observed as late as July 1940 in market gardens near a town to the south-west of Melbourne in which dusting had been inefficiently performed or in which nicotine dusts had been employed, whereas similar neglected gardens in other districts were free from infestation during June, July and August.

Insect Pests and their Control.—*Agric. Gaz. N.S.W.* **51** pt. 9 pp. 513–516, 526, 5 figs. Sydney, 1940.

This part of a series on insect pests in New South Wales [*cf. R.A.E.*, A **29** 237] includes descriptions of the Pentatomid, *Scutiphora pedicellata*, Kby., and the Pyrrhocorids, *Dysdercus sidae*, Montr., and *Dindymus versicolor*, H.-S., all of which attack fruit trees and garden plants, sometimes becoming sufficiently abundant to be injurious. Where control is necessary, the bugs can be repelled by a dust of 2½ per cent. nicotine or one consisting of 1 part pyrethrum and 2 parts talc or kaolin ; a spray of pyrethrum and soap may also be of value.

EVANS (J. W.). **The Canary Fly.**—*Tasm. J. Agric.* **11** no. 3 pp. 160–163, 1 fig. Hobart, 1940.

An account is given of observations on the life-history of *Typhlocyba froggatti*, Baker, in Tasmania, where it feeds on a wide range of rosaceous plants but is generally numerous only on apple trees and hedges of hawthorn (*Crataegus*). In seasons of exceptional abundance it migrates to cherry, plum and pear, and also to rose and ornamental *Crataegus*, but is seldom able to maintain itself in consecutive seasons on these plants, and is never sufficiently numerous on them to be regarded as a pest. The feeding of both nymphs and adults results in the yellowing of the leaves, causing them to drop prematurely.

The overwintered eggs usually hatch during the first week in September, but if temperatures in August are low, hatching may be delayed for 1–2 weeks. The nymphs seldom wander away from the leaves on which they first begin to feed, even when these leaves harden and softer ones become available. In a normal season, adults of the overwintered generation are present at the end of October or beginning of November. The preoviposition period lasts about a week, and the eggs are deposited singly in the midribs and veins of the leaves. They hatch during January, and the first adults of the summer generation, which is the injurious one, emerge from early February until the first or second week in March. The females oviposit mostly in wood of the current season's growth. It has been observed that *T. froggatti* is seldom abundant in neglected orchards in which the trees are not pruned or sprayed and in which the growth of the little new wood that is produced ceases early in the season, since the females cannot oviposit in any but tender shoots. During May, June and July, both nymphs and adults still occur in orchards, suggesting that there is a partial autumn generation, but it is not known whether this results from the hatching of the earliest eggs laid by the summer generation or from eggs laid in leaves instead of in twigs. As the Jassids feed only on the leaves, they die when leaf-fall is complete.

The most effective control is afforded by two applications of a nicotine-sulphate spray [*cf. R.A.E.*, A **28** 323]. The first of these, which can well be combined with the calyx spray against the codling moth [*Cydia pomonella*, L.], should be applied during the first fortnight in November as soon as the majority of nymphs of the overwintered generation have fully developed wing pads and before the adults become numerous. Nicotine sulphate should be used at the rate of 1 pint in 80 gals. water, and if it is used alone, either 1 gal. white oil or 2 lb. soap may be added as a spreader. The second application, which is essential for good control, should be made 3–4 weeks later to destroy any further nymphs that have hatched. Fairly satisfactory control follows the substitution of lime-sulphur for nicotine sulphate in the calyx spray [*cf.* **28** 324], provided that the second spray, which must be of nicotine sulphate, is correctly timed. When possible, spraying should be carried out on sunny days, special attention being paid to the lower surfaces of the leaves. Neglect of either of these sprays necessitates treatment against the first-generation nymphs, which should be timed to coincide with the appearance of individuals in the final instar.

The Mymarid egg-parasite, *Anagrus armatus*, Ashm. [var. *nigriventris*, Gir.], which was introduced against *T. froggatti* in 1935 [*cf.* **26** 208], has been successfully established in a number of orchards, and will be

available for general distribution as soon as its numbers have increased sufficiently. When it is widely spread, it should render spraying unnecessary in most seasons.

LANE (F.). **Notas sôbre Lamiideos neotrópicos. (Col. Lamiidae). III.** [Notes on neotropical Lamiids. III.]—*Bol. biol.* (N.S.) **4** no. 3 pp. 473–479, 2 pls., 6 refs. São Paulo, 1939. (With a Summary in English.) [Recd. 1941.]

The author erects a new genus, *Merocentrum*, for *Gryllica melzeri*, Bondar [*R.A.E.*, A **27** 290], and gives redescriptions of this Lamiid from a male and a female taken on *Coccoloba ilheense* and of *Adesmus borgmeieri*, Bondar [*loc. cit.*] from a female taken in kapok, both in the State of Bahia, Brazil.

PINTO DA FONSECA (J.). & ARAUJO (R. L.). **Insetos inimigos do *Hypothenemus hampei* (Ferr.) (Broca do café).** [The Insect Enemies of the Coffee Berry Borer, *Stephanoderes hampei*, Ferr.]—*Bol. biol.* (N.S.) **4** no. 3 pp. 486-504, 19 figs., 2 pp. refs. São Paulo, 1939. (With a Summary in English.) [Recd. 1941.]

This review of the world literature on the insect enemies of the coffee berry borer, *Stephanoderes* (*Hypothenemus*) *hampei*, Ferr., is followed by notes on an ant, *Crematogaster curvispinosa*, Mayr, which has been found to destroy appreciable numbers of the immature stages of the borer in Sao Pãulo. The ants make their way into the infested fruits by enlarging the entrance holes made by the female Scolytids.

DE FIGUEIREDO jr. (E. R.). **Notas sôbre a *Thyridia themisto* Huebn., 1823, praga do manacá.** Notes on *T. themisto*, a Pest of *Brunfelsia hopeana*.]—*Bol. biol.* (N.S.) **4** no. 3 pp. 512–515, 5 figs., 3 refs. São Paulo, 1939. [Recd. 1941.]

Descriptions are given of all stages of the Danaid, *Thyridia themisto*, Hb., the larvae of which cause considerable damage to *Brunfelsia hopeana* in Santos, often defoliating it completely. The adults begin to appear in numbers at the end of September, soon after *Brunfelsia* has flowered, and oviposit on the lower surfaces of the leaves. The infestation continues until December. The egg, larval and pupal stages lasted 6–7, 20 and 11–12 days, respectively. Some of the larvae are parasitised by a Tachinid and others destroyed by the predacious Vespid, *Polybia occidentalis*, Ol. A spray of 3 lb. lead arsenate in 100 gals. water gives effective control.

BRICEÑO-IRAGORRY (L.). **Nota sobre *Araecerus fasciculatus*, De Geer 1775, Coleóptero atacante del grano del café.** [A Note on *A. fasciculatus* attacking Coffee Beans.]—*Bol. Lab. Clin. Luis Razetti* **1** no. 1 pp. 2–14, 8 figs., 5 refs. Caracas, 1940.

Considerable damage has recently been caused to stored coffee beans in Puerto Cabello, Venezuela, by *Araecerus fasciculatus*, DeG., which was not previously known to be present in that country. The larva, pupa and adult of this Anthribid and the injury caused are described. In experiments, the life-cycle lasted 56 days in coffee beans, and development was also completed in stored maize, which was

readily attacked and more completely destroyed than the coffee beans. The larvae also attacked stored mungo beans (*Phaseolus mungo*), but not other common leguminous seeds. *A. fasciculatus* was not observed in maize stores in various parts of Venezuela, and it is not known how it reached the country.

JERVIS (L. A.). **Insect Pests and Plant Diseases.**—*Rep. agric. mar. Prod. Bd Bahamas 1939* pp. 12–13. Nassau, 1940.

Owing to the activity of the parasite [*Eretmocerus serius*, Silv.] and the spraying campaign carried out by the Agricultural Board, the blue-grey fly [*Aleurocanthus woglumi*, Ashby], which was a serious pest of *Citrus* in the Bahamas, has been brought under control [*cf. R.A.E.*, A **26** 491]. The *Citrus* crop in 1939 was the largest for any year since the introduction of the Aleurodid, and farmers are again planting large orchards.

EDWARDS (W. H.). **The economic Significance of Pests affecting Sugar Cane in Jamaica and an Outline of Surveys in Cane Fields to investigate Conditions which may cause low Yields in Ratoons.**—*Jamaican Ass. Sugar Techn. Quart.* **3** no. 4, 20 pp. Kingston, Jamaica, 1940.

This summary of a paper read at the Annual Conference of Sugar Technologists in December 1939 contains a list of insects that infest sugar-cane in Jamaica arranged under the parts of the plant attacked. Of these, the most important are *Diatraea saccharalis*, F., which bores in the stalks, the Melolonthid, *Lachnosterna jamaicensis*, Arr., and the Dynastid, *Strategus titanus*, F., which damage the roots and rhizomes, and the weevil, *Metamasius sericeus*, Ol., which bores into the stalks and rhizomes [*cf. R.A.E.*, A **28** 495]. The crop is affected to only a small extent, however, by insect pests. Though outbreaks of *L. jamaicensis*, *M. sericeus* and *D. saccharalis* occur occasionally, they have up to now remained restricted to relatively small areas offering particularly favourable environmental conditions, and their control is rapidly and relatively easily obtained by appropriate methods of cultivation.

The results are given of a survey of the percentages of internodes and stalks infested by the larvae of *D. saccharalis* in canes of different varieties on 15 estates [*cf.* **24** 380] ; they showed that these percentages were much below those obtained in other countries.

CUSHMAN (R. A.). **A Review of the parasitic Wasps of the Ichneumonid Genus *Exenterus* Hartig.**—*Misc. Publ. U.S. Dep. Agric.* no. 354, 14 pp., 1 fig. Washington, D.C., 1940.

The species of *Exenterus* discussed comprise eight North American and seven European species that have been or may be introduced into Canada and New England against the European sawflies, *Gilpinia* (*Diprion*) *polytoma*, Htg., *G.* (*D.*) *frutetorum*, F., and *Neodiprion sertifer*, Geoffr., which have become established in North America. A key to them is included. The native species and the hosts and origin of the material examined are *E. diprioni*, Rohw. (a name that the author proposes to amend to *E. diprionis*) and *E. affinis*, Rohw., both bred from *Neodiprion* spp. in the United States and also taken in

Canada ; *E. lophyri*, Vier., known only from the four females of the type series bred from *Zadiprion* (*Neodiprion*) *grandis*, Rohw. [in Nebraska] ; *E. hullensis*, Prov., taken in Canada and the United States ; *E. canadensis*, Prov., redescribed, on account of the uncertainty of its true identity, from both sexes bred from *Neodiprion* spp. in the United States ; *E. flavissimus*, sp. n., from *N. sertifer* in New Jersey ; *E. tsugae*, sp. n., from *N. tsugae*, Middleton, in Oregon ; and *E. pini*, sp. n., bred from cocoons of a Tenthredinid in the Nebraska National Forest and collected in Colorado. Both sexes of the new species are described.

The European species and the material examined are *E. tricolor*, Roman, bred from *G. polytoma* from Czechoslovakia ; *E. adspersus*, Htg., from *D. pini*, L., in Finland, *D. similis*, Htg., from Poland, *G. polytoma* from Czechoslovakia, and *N. sertifer* and *D. nipponicus*, Rohw., in Japan and one female collected in Korea ; *E. marginatorius*, F., comprising males and females from Europe, identified by European workers, and males and females bred from *G. polytoma* in Canada and from *D. similis* from Poland, received from the Dominion Parasite Laboratory and labelled *E. adspersus* ; *E. claripennis*, Thoms., from *G. polytoma* in Sweden and Czechoslovakia ; *E. abruptorius*, Thnb., including males and females from *N. sertifer* in Hungary and Japan, a single male from Korea, and both sexes from *N. sertifer* and a male from *G. polytoma*, forwarded by the Dominion Parasite Laboratory ; *E. oriolus*, Htg., from *N. sertifer* in Hungary ; and *E. vellicatus*, sp. n., described from both sexes bred from *G. polytoma* from Czechoslovakia and a single female from Germany. In the case of all these species except *E. oriolus* and *E. claripennis*, the specimens examined included some reared from imported material in Canada.

The author gives characters distinguishing *E. affinis* from *E. diprioni*, of which it has been considered a synonym [*R.A.E.*, A **22** 67]. *E. laricinus*, Thoms. [*cf.* **27** 671] and *E. oleaceus*, Uch. [**28** 339] are considered synonyms of *E. adspersus*, on the basis of the original description and a comparison of Japanese and European specimens, respectively. Records of the establishment of *E. adspersus* in Canada as a parasite of *G. polytoma* [*cf.* **26** 487 ; **27** 369] are considered to refer to *E. marginatorius*, which is the only species of which the author has seen specimens bred from North American host material and which appears to be the only exotic species of the genus released in North America that has become established [*cf.* **25** 13 ; **28** 351, 515 ; **29** 39]. *E. abruptorius* has been released in the United States against *G. polytoma* and *N. sertifer* and in eastern Canada against *G. polytoma*, but has not been recovered. Its preferred host in Europe appears to be *N. sertifer*, but it has also been recorded from *D. pini*. *E. tricolor* has been released in spruce forests infested with *G. polytoma* in eastern Canada [*cf.* also **28** 339], but there is no record of its having been recovered.

ALLEN (H. W.), HOLLOWAY (J. K.) & HAEUSSLER (G. J.). **Importation, Rearing, and Colonization of Parasites of the Oriental Fruit Moth.** —*Circ. U.S. Dep. Agric.* no. 561, 61 pp., 15 figs., 5 refs. Washington, D.C., 1940.

The following is based on the authors' summary. An account is given of the work carried out by the United States Bureau of Entomology and Plant Quarantine between 1929 and 1935 in importing, breeding and distributing parasites of *Cydia* (*Grapholitha*) *molesta*, Busck.

Seven species of parasites of *C. molesta* found in Europe, two out of ten found in Australia and 17 out of about 65 found in Japan and Korea were imported. The method of handling the material is described. A technique was developed to provide large numbers of the desired species of a high degree of vitality and vigour at a period suitable for liberation, and to prevent any possibility of the accidental introduction of undesirable host insects or hyperparasites. Details are given of the material imported and the numbers of parasites obtained from it. The parasites obtained directly from importations were supplemented by extensive breeding in the laboratory at Moorestown, N.J., large numbers of native and imported parasites of the larvae of the twig-infesting generations and imported parasites of the eggs and pupae being bred by methods that are described. One of the most important phases of this work was the production of supplies of the indigenous parasite, *Macrocentrus ancylivorus*, Rohw., and its colonisation throughout the area infested by *C. molesta*. The principal imported species that were bred for release were *Microdus* (*Bassus*) *diversus*, Mues., *Angitia* (*Inareolata*) *molestae*, Uch., *Trichogramma euproctidis*, Gir., *Phanerotoma grapholithae*, Mues., *Ascogaster quadridentata*, Wesm., and *Perisierola angulata*, Mues. The total numbers of parasites obtained from importations and mass breeding of imported and indigenous stock between 1929 and 1935 are shown in a table. Details are given of the methods of collecting, sorting, transporting and liberating the parasites. Since many of the releases were made in districts several hundred miles from the laboratory, special attention was given to methods of transportation. Ice boxes forwarded by railway express proved satisfactory for transit periods up to 60 hours, and unrefrigerated packages sent by air express were satisfactory if the journey could be completed within 30 hours. Each of the 1,093 separate liberations made is listed as to State, county and town in which the release was made and the number released in each colony. The species of parasites released in each county are shown in a separate list. The circular concludes with a brief discussion, for each of the species of parasites handled, of available information pertaining to importing, breeding and shipping for release.

Persing (C. O.), Boyce (A. M.) & McCarty (F. G.). **Field Studies on Control of Citrus Thrips on Lemons and Oranges.**—*Calif. Citrogr.* **25** nos. 5 & 6 pp. 134, 170–172, 176–177, 204–206, 3 figs. Los Angeles, Calif., 1940.

In view of the recent increase in importance of *Scirtothrips citri*, Moult., on lemons in southern California [*cf. R.A.E.*, A **27** 432], investigations were begun in 1936 on its control on this food-plant, on which a constant production of young growth and small fruits permits its continuous development from spring to autumn [*cf.* **27** 433]. The nature of the injury to lemon [*loc. cit.*] and the method of evaluating the field results by determining the population density of the thrips before and after treatment are described.

Various winter sprays used against the eggs and dusts applied to the soil surface against the full-fed larvae and pupae did not give satisfactory control. Contact insecticides tested against the larvae and adults on the tree included sulphur dust and sprays containing sulphur and its compounds. Yellow dusting sulphur with a particle size of 30–40 microns (passing through a 325-mesh screen) gave heavier

deposits than finer or coarser dusts, remained on the trees longer and gave better control of the thrips with less damage to the fruit at high temperatures. A number of insecticides, including flotation sulphur, were mixed with dusting sulphur, and in most cases they improved the control, but, in view of the much greater cost of the materials, their addition is not recommended when the thrips is the only pest to be controlled. Certain other dusts and sprays were tested, but though some of them gave a high initial mortality, there was little residual action. The addition of metallic zinc or zinc compounds to the sulphur had no effect on the degree of sulphur injury, and zinc sulphide reduced the control. Comparative tests showed that a single application of a spray containing 1½–2 U.S. gals. lime-sulphur and 4–8 lb. wettable sulphur per 100 U.S. gals. is approximately equal to two of sulphur dust, particularly during spring [*cf. loc. cit.*] ; that the spray injures the fruit at lower temperatures and under less favourable conditions for sulphur injury than the dust ; that the addition of 6 lb. zinc sulphate per 100 U.S. gals. reduces the injury caused by the spray to fruit and new growth but also materially reduces its effectiveness against the thrips ; and that the inclusion in the spray of hydrated lime or of potassium hydroxide and resin soap increases the injury to foliage and fruit without affecting the control of the thrips. Ammonium polysulphide, applied as a spray at concentrations of 1½–2 per cent., gave results intermediate, as regards both control and injury to the fruit, between those from sulphur dust and the spray of lime-sulphur and wettable sulphur.

Of the stomach poisons tested, the organic antimony compounds were the most promising, potassium antimony tartrate (tartar emetic) and calcium antimony tartrate, the active ingredient in a proprietary product known as Antimonelle, being the best as regards availability, cost and toxicity. In experiments on oranges and lemons in various districts, sprays of tartar emetic and sugar were superior to Antimonelle and sugar at the same concentrations, and a spray containing 2 lb. tartar emetic per 100 U.S. gals. afforded better protection to lemons than one containing 1½ U.S. gals. lime-sulphur and 4 lb. wettable sulphur. Saccharine, which is sweet but not hygroscopic, and calcium chloride, which is hygroscopic but not sweet, were both less effective when used with tartar emetic than glycerine, which is slightly sweet and hygroscopic, and glycerine was less effective than sugar. Wetting agents incorporated in the sprays did not increase their effectiveness. The effect of different concentrations of sugar and tartar emetic on thrips control was tested on oranges and lemons, and the results on lemons are shown in a table. There was no significant difference in effectiveness between sprays containing 1, 2, 4 and 8 lb. sugar with 2 lb. tartar emetic per 100 U.S. gals. either 40 or 65 days after treatment. Sprays containing 4 lb. sugar and 4, 2, 1 and ½ lb. tartar emetic per 100 U.S. gals. gave 98·9, 98·5, 97 and 86·7 per cent. control, respectively, after 40 days, and 77·8, 81·4, 44·1 and 17 per cent. after 65 days. There was a heavy flush of new growth after six weeks on all the treated plots but practically none on untreated trees.

To determine the most efficient method of applying tartar emetic, various dust combinations of this material were compared with sprays. A dust made by grinding together dry powdered tartar emetic, sugar and talc or walnut-shell flour, which was found to be more effective than one made by atomising a water solution of tartar emetic and sugar on to

the diluent, was used in these tests. Dusts containing 20 per cent. each of tartar emetic and sugar and 10 per cent. of each, respectively, were about equally effective after 40 days, but the more concentrated dust was much more effective after 65 days. Both, used at the rate of 1 lb. dust per large tree, gave less effective thrips control and growth response than the sprays containing sugar and 1–4 lb. tartar emetic per 100 U.S. gals. and were more expensive. Methods of applying the sprays are discussed. A very light outside coverage of 4–5 U.S. gals. spray per large lemon tree was found to give satisfactory results. In preliminary experiments, designed to reduce the cost of the treatment by the rapid application of more concentrated solutions, treatment with 4 U.S. gals. per tree of a spray of 1 lb. tartar emetic and 2 lb. sugar per 100 U.S. gals. appeared to be less effective than treatment with half the quantity of a solution of twice the concentration. The compatibility of tartar emetic with other substances and the precautions to be taken in handling it are discussed. No spray injury occurred on undamaged fruit, but limited areas of fruit and foliage that had previously been damaged by the thrips were injured to a degree directly proportional to the concentration of tartar emetic. It is doubtful whether this injury further lowered the grade of the fruit. No difficulty was found in removing residues on fruit that received as many as five sprays of tartar emetic at a concentration of 4 lb. per 100 U.S. gals. to a safe level by ordinary packing-house washing.

The treatment recommended for lemons on the basis of these results is two applications of about 5 U.S. gals. per large tree of a spray containing 1½ lb. tartar emetic and 2 lb. sugar per 100 U.S. gals., one in May and the other in July or August, though further applications may be necessary. On oranges, which are satisfactorily protected in spring by dusts of sulphur or sprays of lime-sulphur and wettable sulphur [**27** 433] but need a late summer treatment to reduce the thrips population and permit a normal autumn flush of growth, 1 lb. tartar emetic and 2 lb. sugar per 100 U.S. gals. should be applied at the same rate during the summer.

FLANDERS (S. E.). **Biological Control of the Long-tail Mealybug on Citrus and Avocado.**—*Calif. Citrogr.* **25** no. 5 pp. 146, 154–155, 3 figs., 1 ref. Los Angeles, Calif., 1940.

Pseudococcus adonidum, L. (*longispinus*, Targ.), which has been present on *Citrus* in southern California for many years and suddenly assumed outbreak proportions in 1933, has become a major pest of avocado during the last few years, so that, in one county, it has been found necessary to liberate large numbers of *Cryptolaemus* [*montrouzieri*, Muls.] annually to reduce the infestation. The only parasites known to attack *P. adonidum* in California were *Pseudaphycus angelicus*, How., and *Coccophagus gurneyi*, Comp. The latter is present throughout the range of the mealybug, but is not well adapted for parasitising it [*cf. R.A.E.*, A **25** 711]. Neither gives effective control.

Following the outbreak in 1933, *Anarhopus sydneyensis*, Timb., was introduced from Australia late in that year and liberated in an infested orange orchard in March 1934 [*cf.* **23** 30]. The orchard was free from infestation by November 1934, and there has been a noticeable decrease in the numbers of *P. adonidum* in the vicinity since this Encyrtid has become established. It was not actually

recovered from *P. adonidum* on *Citrus*, however, until the autumn of 1939. In the coastal districts of southern California, where *Dracaena* is a preferred food-plant of *P. adonidum*, a heavy infestation of a group of trees was completely controlled as a result of liberation of *A. sydneyensis*, in December 1934; a light infestation reappeared in 1939. In 1934, *Tetracnemus peregrinus*, Comp., which was found attacking *P. adonidum* in Brazil [*cf.* **28** 372], was introduced into California and propagated in the insectary. It was released in two districts in March and April 1935 on orange and *Dracaena*, respectively. It is established in one district and appears to be controlling the mealybug on *Dracaena*, but has not yet been recovered in the other. Another Encyrtid, *Anagyrus fusciventris*, Gir., which had been observed attacking *P. adonidum* on quince in New South Wales and was known to occur in Hawaii, was introduced from Hawaii in April 1936, propagated in the insectary, where the development of a generation required about 24 days, and released in three localities during May, June and July. It was recovered in one locality in December 1939, but seems to have little influence on the population of *P. adonidum*; it is recorded from Hawaii that outbreaks of the latter occurred on pineapple on Lanai during 1932–33, although the parasite was present.

The distribution of the introduced parasites is still confined largely to the colonised areas, and insectary propagation and distribution of the more effective of them is recommended for use against the mealybug on avocado.

RITCHER (P. O.). **Kentucky White Grubs.**—*Bull. Kentucky agric. Exp. Sta.* no. 401 pp. 71–157, 6 pls., 40 figs., 40 refs. Lexington, Ky., 1940.

Lamellicorns, chiefly species of *Lachnosterna* (*Phyllophaga*), are widely distributed in Kentucky, where 36 species of this genus are found. The genitalia of both sexes of all these species are figured, and a key is given to the larvae of 23 of them. Their presence and prevalence vary with the physical regions of the State, many of which are characterised by the dominance of certain species. The injury they cause is mostly limited to larvae feeding in strawberry patches and the defoliation of shade and forest trees by the adults, but they are considered to be of great potential importance.

Life-history studies indicated that in Kentucky some species of *Lachnosterna* complete their life-cycle in two years, some in three years, and others in either two or three. An account is given of observations on hibernation of the adults, from which it is concluded that they spend at least the first part of the winter in the pupal cells, some species beginning to burrow toward the surface in January or February. Details are also given of the sequence of emergence, seasonal abundance, and the feeding preferences of the adults of many species for a number of the State's physical divisions. *L.* (*P.*) *hirticula*, Knoch, is responsible for most of the defoliation of oaks in May in the inner bluegrass belt, where it is the dominant species. Investigations with light-traps showed that the common 100-watt white frosted bulb is more effective than similar 60- or 200-watt bulbs.

Females were found to lay approximately 50 eggs, which hatched in 15–29 days, depending on the species and the temperature of the soil. Details of larval life in the soil and food-preferences are given.

The time of pupation and the duration of the pupal stage are discussed, and evidence is given that some species, such as *L. hirticula*, pupate deep in the soil, while others, such as *L.* (*P.*) *inversa*, Horn, and *L.* (*P.*) *ephilida*, Say, pupate close to the surface [*cf. R.A.E.*, A **27** 592].

Lamellicorns other than *Lachnosterna* of which the life-histories are discussed are *Cyclocephala immaculata*, Ol., *Anomala innuba*, F., *A. nigropicta*, Csy, and *A. flavipennis*, Burm., and mention is made of *C. borealis*, Arr., *A. binotata*, Gylh., and *Cotinis nitida*, L.; all of these have one-year life-cycles.

Common natural enemies of Lamellicorn larvae in Kentucky include *Myzine quinquecincta*, F., several species of *Tiphia* (including *T. intermedia*, Mall.) and Asilids. The pupae are attacked by the larvae of the Bombyliid, *Exoprosopa fasciata*, Macq. [*cf.* **23** 330], and the Asilid, *Diogmites discolor*, Lw., while *Pyrgota* spp. and Sarcophagids parasitise the adults.

THOMAS (C. A.). **The Biology and Control of Wireworms. A Review of the Literature.**—*Bull. Pa agric. Exp. Sta.* no. 392, 90 pp., 13 pp. refs. State College, Pa., 1940.

This bulletin, which supplements one published in 1930 [*cf. R.A.E.*, A **19** 120], contains summaries of information given in about 400 papers on the biology and control of wireworms that have been published in various countries since that date. The data are classified under a series of subject headings so that they are easy to find and compare, and no attempt is made to draw conclusions from them.

DAHMS (R. G.) & MARTIN (J. H.). **Resistance of F_1 Sorghum Hybrids to the Chinch Bug.**—*J. Amer. Soc. Agron.* **32** no. 2 pp. 141–147, 1 fig. 1940. (Abstr. in *Exp. Sta. Rec.* **83** no. 2 pp. 220–221. Washington, D.C., 1940.)

It was found impossible in the experiments described to determine the inheritance of resistance to chinch bugs [*Blissus leucopterus*, Say] by measuring the injury to the *Sorghum* plants because of the frequent occurrence of hybrid vigour, which enabled them to escape serious injury. Egg counts on 11 hybrids and their parents [*cf. R.A.E.*, A **25** 244] indicated that in most of the crosses resistance was dominant to susceptibility. The extent of hybrid vigour, as measured by height of plant, diameter of stalk and number of tillers, did not appear to be definitely associated with resistance to *B. leucopterus*, as measured by oviposition and female longevity. In general, the females lived longer on the susceptible varieties [*cf. loc. cit.*], but the difference was small, and the duration of life is a poorer criterion for measuring resistance than is the number of eggs laid.

UNDERHILL (G. W.) & COX (J. A.). **Carbon Disulphide and Dichlorethyl Ether as Soil Fumigants for the Woolly Aphid** (*Eriosoma lanigerum* **Hausm.).**—*Va Fruit* **28** no. 2 pp. 20, 22, 24, 26. 1940. (Abstr. in *Exp. Sta. Rec.* **83** no. 2 p. 221. Washington, D.C., 1940.)

Cage and orchard tests in Virginia, the results of which are shown in tables, indicated that either carbon bisulphide emulsion (1 : 1,600) or dichloroethyl ether solution (1 : 800), applied to the soil at the rate

of 1 U.S. gal. per sq. ft., gave satisfactory control of *Eriosoma lanigerum*, Hsm., on the roots of apple without causing perceptible injury to the latter. Neither gave such satisfactory control when applied at half the rate, and when carbon bisulphide emulsion was applied at rates of 2 and 3 U.S. gals. per sq. ft., it scorched the roots and in some cases killed the trees.

WALTON (W. R.) & PACKARD (C. M.). **The Armyworm and its Control.** —*Fmrs' Bull. U.S. Dep. Agric.* no. 1850, 11 pp., 8 figs. Washington, D.C., 1940.

Descriptions are given of all stages and the life-history of the Noctuid, *Cirphis unipuncta*, Haw., which causes considerable injury to cereals and forage crops in the United States, where it occurs in most of the region east of the Rocky Mountains, and has also been found in New Mexico, Arizona and California. Severe outbreaks extending from the Gulf States to Canada occurred in 1937, 1938 and 1939. The preferred food-plants are wild and cultivated grasses and grasslike grains such as the various kinds of millet; wheat, maize, oats and rye are also readily attacked, and during a severe infestation all aerial parts of the plant may be destroyed. Infestation usually appears suddenly, and it seems certain that the moths sometimes migrate in great numbers and for many miles in the direction of the prevailing wind and congregate on suitable plants for oviposition. Outbreaks generally follow a cold late spring, and young larvae may appear in fields from late April to early July. There are usually three broods of larvae in any one year, but seldom two successive outbreaks in any one locality. Winter is passed in the larval stage, and possibly also in the pupal stage in the Central States, while evidence has been obtained indicating that all stages may be present during the winter in the extreme south.

The larvae are parasitised by the Tachinid, *Winthemia quadripustulata*, F., the Braconid, *Apanteles militaris*, Walsh, and the Ichneumonid, *Enicospilus purgatus*, Say, and are attacked by the Carabid, *Calosoma calidum*, F., and a predacious Sphegid.

Poison baits afford the best method of control [*cf. R.A.E.*, A **26** 540; **28** 370]; efficient ones consist of a mixture of 100 lb. wheat bran and 4 lb. Paris green or white arsenic moistened with 12 U.S. gals. water, or of 100 lb. bran moistened with 12 U.S. gals. water containing 2 U.S. quarts of liquid sodium arsenite. This quantity is sufficient for 3–5 acres. When bran cannot be readily obtained, an equal amount of coarse lucerne meal or cotton-seed hulls, coarsely ground or unground, can be substituted for it, but in such cases 1 U.S. gal. crude cane molasses should be stirred into the water before mixing. The bait should be broadcast thinly over the infested field late in the afternoon.

Although dusting with arsenicals from an aeroplane is considerably more expensive and frequently less effective than a poison bait, it has been practised with fair success on small grains in the southern States. Calcium arsenate alone or mixed with a small percentage of Paris green has given good results when applied by this method in the early morning or late afternoon at the rate of 15–30 lb. per acre, according to the thickness of the grain. Where farm operations are varied and fields fairly small, however, baiting is the most practical measure.

When the larvae are not observed until they are beginning to migrate in masses, many of them can often be destroyed by surrounding the infested area with a furrow or ditch, which is more effective

if it has post-holes in it at intervals of about 20 ft. The larvae that fall into them can be destroyed by crushing them with a log or by sprinkling them with kerosene. In hot weather, the larvae sometimes die in the holes without any treatment.

ALLEN (T. C.) & BROOKS (J. W.). **The Effect of alkaline Dust Diluents on Toxicity of Rotenone-bearing Roots as determined by Tests with Houseflies.**—*J. agric. Res.* **60** no. 12 pp. 839–845, 6 refs. Washington, D.C., 1940.

An account is given of investigations on the effect on the toxicity of dusts prepared from the roots of derris, cubé and barbasco (Malayan *Derris elliptica* and Brazilian and Peruvian species of *Lonchocarpus*) of diluents widely differing in pH values [*cf. R.A.E.*, A **25** 560]. The mixed dusts contained 1 part ground root and 9 parts diluent. Samples of the ground roots and mixed dusts were moistened with distilled water and, together with unmoistened samples used as controls, were stored in a dark unheated room for 7 days, during which their moisture content was maintained at 48 per cent. by the daily addition of water; their pH values were determined at various intervals by the glass electrode method, which is described, and the results are given in tables. After storage, the dusts were thoroughly dried, repowdered and passed through a 100-mesh screen, and their relative toxicity was tested by subjecting five-day-old houseflies (*Musca domestica*, L.) in a bell jar for 2 minutes to settling mists of kerosene extracts of them. The results showed that when stored under moist conditions, the ground roots and the mixtures made up with acid diluents (calcium sulphate, sulphur and gypsum) increased in acidity and retained their toxicity. Those made up with highly alkaline diluents (talc, magnesium carbonate, tobacco filler and hydrated lime) showed no change in pH but considerable decrease in toxicity. Thus, the percentage mortalities given by the sulphur mixtures after damp storage averaged 98·8–99·6, while those given by the hydrated-lime mixtures averaged 91·4–94·4 for dry-stored samples, but only 6·5–41·1 for those stored under damp conditions. When 9 parts sulphur was added to 1 part of the highly alkaline dust mixtures and the dusts stored under moist conditions, they showed practically no loss of toxicity.

Under laboratory conditions, the moist-stored ground roots and acid mixtures commonly produced growths of various micro-organisms, and rapid fermentation occurred as a result of the presence of carbohydrates in the roots, giving rise to the formation of organic acids. This did not occur in the mixtures with highly alkaline diluents. Dry-stored roots showed no change in pH and no apparent growth of micro-organisms during storage. To determine the minimum amount of moisture that would bring about deterioration in toxicity, samples of four representative dusts were dried and stored for 7 days at 73°F. and 61 per cent. relative humidity. The percentage moisture content of the samples after storage ranged from 0·3 to 9·7, and the alkaline dusts showed as great a loss of toxicity as the earlier damp-stored samples.

SEVERIN (H. H. P.). **Potato naturally infected with California Aster Yellows.**—*Phytopathology* **30** no. 12 pp. 1049–1051, 1 fig., 3 refs. Lancaster, Pa., 1940.

Aster yellows has been transmitted by *Macrosteles* (*Cicadula*) *divisus*, Uhl., to potato in California [*cf. R.A.E.*, A **23** 412] but not

in New York [**19** 580]. In this note, the author states that in the Montara Mountains, near San Francisco, the virus is transmitted by a variety or physiological race of this Jassid that has longer elytra than the usual form but is otherwise morphologically indistinguishable from it. The two forms will not interbreed. Many ornamental plants in the coastal valleys of these mountains are affected with aster yellows. In experiments, two lots of 20 non-infective adults of the long-winged Jassid were allowed to feed for an average of 4 days on a volunteer potato plant that was collected in one of the valleys in October 1916 and showed purple, sessile, aerial tubers. They were then transferred to two healthy aster plants, which subsequently developed typical symptoms of aster yellows.

Eight potato plants showing aerial tubers were collected near Colma, but long-winged and short-winged Jassids failed to transmit the aster-yellows virus from them to asters. Nymphs and adults of *Paratrioza cockerelli*, Šulc, were present on them, and the cause of the disease was psyllid yellows. Plants grown from tubers from these 8 potato plants failed to show symptoms of psyllid yellows. Aster leafhoppers failed to recover the aster-yellows virus from the plants grown from tubers and transmit it to healthy asters.

Livingstone (E. M.) & Reed (W. D.). **Water Vapor as a Factor affecting the Survival of** *Ephestia elutella* **and** *Lasioderma serricorne* **at reduced Pressure.**—*Ann. ent. Soc. Amer.* **33** no. 3 pp. 583 587, 8 refs. Columbus, Ohio, 1940.

The following is substantially the authors' summary. The evaporation or absorption of water vapour and the mortality that resulted from subjecting mature larvae of *Ephestia elutella*, Hb., and mature larvae and adults of *Lasioderma serricorne*, F., for eight hours to artificially reduced pressures in dry and in water-saturated atmospheres equivalent to an absolute pressure of 2 ins. of mercury were studied. The results showed that in dry air water was lost and mortality was considerable, as compared with almost negligible water loss and mortality in water-saturated air. Evaporation and the percentage mortality were reduced by the addition of oxygen to the dry chamber [*cf. R.A.E.*, A **25** 697], but not greatly altered by the addition of carbon dioxide or nitrogen. Evaporation and mortality produced in the water-saturated atmosphere by the addition of nitrogen, oxygen or carbon dioxide were not great.

Gorham (R. P.). **The Potato Aphid Survey in New Brunswick and adjacent Provinces.**—*Rep. ent. Soc. Ont.* **70** (1939) pp. 23 25. Toronto [1940].

The results are given of annual surveys to determine the distribution and fluctuations in population of Aphids that occur on potato in eastern Canada ; they were begun in 1934 in New Brunswick [*R.A.E.*, A **24** 150] and were later extended to include Prince Edward Island and parts of Nova Scotia and Quebec. After the general distribution of the Aphids had been determined, attention was largely confined to the commercial potato-growing areas, and in 1938 and 1939 almost entirely to fields grown for certified seed production ; by this means the desirability for seed production of plants in fields in which Aphids are present and the districts most suitable for the raising of seed stock free from Aphid-transmitted virus disease can be determined.

In all, 5,939 samples were collected from 1934 to 1939, inclusive. The four species concerned were, in order of abundance, *Macrosiphum solanifolii*, Ashm., *Aphis rhamni*, Boy. (*abbreviata*, Patch), *Myzus persicae*, Sulz., and *Macrosiphum solani*, Kalt. (*Myzus pseudosolani*, Theo.). *Macrosiphum solanifolii*, which was the commonest in all four Provinces, occurs on potato from late June until late August and is most abundant in late July ; the population varies considerably from year to year, but the species is generally present during the mid-season period. *A. rhamni*, which is found on the under surfaces of the lower leaves, often under very moist conditions, did not occur in all districts. *Myzus persicae* appears on the plants in the second week of July in Nova Scotia and rather later in New Brunswick, reaching maximum abundance in the second week of August ; when potato plants are no longer available, it feeds on weeds, particularly crucifers. *Macrosiphum solani* occurs locally in some districts and is most abundant during the second week in August. All four species were attacked by fungi and insect enemies, but *A. rhamni* was less attacked by insect parasites and predators than the larger species.

Stirrett (G. M.) & Wood (A. A.). **Preliminary Notes on the Life-history and Biology of the Tobacco Worm,** *Phlegethontius quinquemaculata* **Haw. in Ontario.**—*Rep. ent. Soc. Ont.* **70** (1939) pp. 25–27, 1 fig., 2 refs. Toronto [1940].

Observations on the seasonal occurrence of *Protoparce* (*Phlegethontius*) *quinquemaculata*, Haw., on tobacco were made in 1938 and 1939 in the centre of the flue-cured tobacco district of Ontario. In each year, eggs were found in the field on the same day as the first adults of the season, and there was only one generation. Eggs were observed from 8th July until 25th July in 1938 and from 28th June until 24th August in 1939, when infestation was exceptionally heavy. Larvae were observed from 15th July until 28th August in 1938 and from 7th July until 8th October in 1939. In the three preceding years, sprays were applied as soon as young larvae were observed, and the spraying dates were 3rd August, 16th July and 12th July, respectively. There was one egg to an average of 3·8 and 2 plants, respectively, during the period of maximum oviposition in 1938 and 1939 ; at the height of larval abundance there was 1 larva to 1·9 plants in 1938, and 1·3 larvae per plant in 1939. The total infestation of both eggs and larvae at the apparent height of the season was 0·6 per plant on 25th July 1938 and 1·6 on 19th July 1939. In 1938, 90·5 per cent. of the eggs were deposited on the lower surface of the leaf, most being situated about $\frac{1}{2}$ in. from the edge, on the upper third of the plant. When spraying was promptly and efficiently carried out, one application was sufficient for control in 1938, and two in 1939.

Thompson (R. W.). **Further Notes on Corn Borer Resistance in Hybrid Corn with a brief Statement of the Infestation Situation in Ontario in 1939.**—*Rep. ent. Soc. Ont.* **70** (1939) pp. 27–30. Toronto [1940].

Work on the resistance of various strains of maize to the European corn borer [*Pyrausta nubilalis*, Hb.] in Ontario [*R.A.E.*, A **28** 423] was continued in 1939, when 61 standard varieties and hybrids were investigated at two stations. The average borer populations of each

strain in 1939 and also in 1938 for those that were grown in both years are shown in tables. At both stations, the difference between infestation on the standard varieties and the hybrids was considerably less than in 1938, but fairly good resistance was exhibited by a number of the hybrids in both years. Some of the hybrids also possessed satisfactory agronomic features.

In four counties in the western maize-growing area, where humidity was low during late June, July and early August, the percentage of stalks infested was less than in 1938, whereas in a number of localities in southern and eastern Ontario, where humidity was high throughout the season, particularly in June and July, it was greater than in any previous year for which figures are available.

McNally (A. G.). **A Test of Sodium Fluoride Bait in the Control of the European Earwig in Ontario.**—*Rep. ent. Soc. Ont.* **70** (1939) pp. 30–33, 3 refs. Toronto [1940].

Preliminary tests in 1938 indicated that a heavy infestation of *Forficula auricularia*, L., in a village in Ontario [*R.A.E.*, A **27** 601] might be controlled by means of a poison bran bait, and in this paper an account is given of its successful use there in 1939.

First-instar nymphs, a few of which were active at night, were observed on 8th June, and on 15th June, after a cold spell, nymphs in the second and third instars were present, generally in nests below the turf. On 20th June, most were in the third instar, but a few were already in the fourth; on 23rd June both third- and fourth-instar nymphs were present, and by 3rd July many had completed their development and left the nests, some having entered houses, where they were active by night. It is stated that the Oregon formula was used for the bait and that this is 2 lb. bran, 12 oz. sodium fluoride, 2 U.S. quarts molasses and 6 U.S. quarts water [*sic cf.* **16** 105], but also that 1 ton bran and 100 lb. sodium fluoride was sufficient for two applications in the village, which contained about 100 houses. The bait was applied on 3rd and 5th July, but the second application was omitted on the outskirts of the village, owing to the high mortality given by the first. Where possible, the bait was covered in order to preserve its effectiveness for several days. No attempt was made to obtain accurate statistical results, but of 1,560 earwigs collected from three heavily infested areas just before the second application, only 576 were still active. During a search lasting 45 minutes made 22 days later, only 7 living earwigs were found.

Later in the season, some infested farms were discovered in the neighbourhood, and the district round a town about six miles away also showed general infestation; there are consequently no prospects of complete eradication.

Putman (W. L.). **The Plum Nursery Mite** (*Phyllocoptes fockeui* **Nal. and Trt.**).—*Rep. ent. Soc. Ont.* **70** (1939) pp. 33–40, 4 figs., 6 refs. Toronto [1940].

Phyllocoptes fockeui, Nal. & Trt., all stages of which are briefly described, was first recorded from Ontario in 1928; it is not present elsewhere in North America, but is common on plum in England and occurs in France and in Austria, where it has been taken on sour cherry. In Ontario, it attacks plum nursery stock, principally European plum;

no visible injury was noticed on the Myrobalan plum, *Prunus cerasifera*, which is used as stock, or its variety *pissardi*, and Japanese and American varieties are immune. The mites, which occur chiefly on the lower surfaces of the young leaves, are often common on mature trees, especially on terminal shoots and watersprouts, but cause severe damage only to nursery stock. The injury is characterised by curling and dwarfing of the foliage and a brown or bronze scurfy condition of the lower surfaces of the leaves and is probably often confused with that caused by *Empoasca fabae*, Harr., from which, however, it can be distinguished by the distortion of the very small terminal leaves, the curling of the lateral margins of the leaves rather than the tips, and the scurfy lower surface.

The bionomics of this Eriophyid were studied during 1937–39. The mites were kept in a screened insectary on potted seedlings of Myrobalan plum, since the hairy lower surface of the leaves rendered European stock unsuitable for rearing purposes ; they were confined within celluloid cells about $\frac{1}{8}$ in. in diameter, and these and the rearing technique employed are described. The method was successful for the immature stages, but the data obtained for the more active adults were less reliable. Eggs hatched in 2–15 days (generally 3–4 days in warmer weather). The average durations of the larval and nymphal stages were 2·1 and 1·7 days, respectively, and their combined length, which varied from 2 to 18 days, was usually 3–4 days in mid-summer. The complete life-cycle generally lasted 7–12 days, but ranged from 6 to 22. The numbers of eggs deposited by an individual female varied from 1 to 79. The pre-oviposition period was usually 1 day, but in early spring and late autumn it was 3 days or more ; 1–5 eggs were deposited daily, but oviposition was irregular, probably as a result of experimental conditions. Most of the females that deposited more than 50 eggs lived for 20–31 days, but in late autumn a few lived as long as 6 weeks. Males generally comprised 20–30 per cent. of the population, but the percentage varied from 10 to 60. Of 118 offspring reared from fertilised females, 27 per cent. were males, but eggs from unfertilised females all gave rise to males. It appeared, however, that females could be fertilised by their offspring. Only females survived the winter, and as the first eggs laid by them gave rise to both sexes, it is concluded that they are fertilised before entering hibernation.

The females overwinter in clusters of 20 or more in the cavities of dead buds, in crevices in the twigs and bark, within the margins of the outer scales of healthy buds, and possibly about the trunks below the soil surface. All those observed to hibernate in healthy buds were dead by spring, but circumstantial evidence indicated that in some cases they survive. In spring, the mites leave the partly expanded buds and scatter over the foliage, on which they feed for a few days before ovipositing. In 1939, which was a normal season, they were first observed on 5th May ; the first larvae hatched on 19th and adults appeared on 27th May. Small colonies were present on the mid-ribs of the lower surfaces of the leaves in early June, and these rapidly increased in numbers, reaching a maximum at the end of July, after which the increase was limited by predators and the slowing of tree growth. The injury is generally greatest during late June and July, but continued until September in a year in which the growing season was prolonged by heavy midsummer rains. As many as 13–15 generations were produced during a year, but only some are complete,

since females may live more than twice the average length of a generation. Overwintering females, distinguishable by the absence of well-developed ova, were first observed in the buds on 5th August in 1937 and 8th August in 1938, and in 1939 they began to enter the buds between 17th and 25th July. The stimulus leading to the production of the overwintering forms was found to be the hardening of the foliage. Breeding continues as long as there is any young foliage, and in both 1938 and 1939 all stages were present on 1st November, after 3 degrees of frost.

Predators comprised a mite of the genus *Seiulus*, young nymphs of the Anthocorid, *Orius insidiosus*, Say, and larvae of two or more Cecidomyiids. Only *Seiulus* was of any importance, but it did not appear until the end of July in 1937 and 1938 and the end of August in 1939. Mortality is heavy among overwintering females of *P. fockeui* in winter and also in summer after they enter the buds, probably owing to desiccation. Rainfall has an indirect effect on the population, by prolonging the period during which young foliage is available. It is probable that the mite is introduced annually on Myrobalan plum seedlings imported from Europe as rootstocks, and is spread by the use of infested material for budding and by wind. It was also found to be disseminated by insects, 4 examples being obtained from a collection comprising 15 of *Philaenus leucophthalmus*, L., 10 of *E. fabae* and a few Chironomids, swept from above severely infested plum stock. Another Eriophyid, *Epitrimerus gigantorhynchus*, Nal., was occasionally associated with *P. fockeui*, but was of no economic importance.

ARMSTRONG (T.) & PUTMAN (W. L.). **The Plum Leafhopper (*Macropsis trimaculata* Fitch) in Ontario.**—*Rep. ent. Soc. Ont.* **70** (1939) pp. 41–48, 8 figs., 5 refs. Toronto [1940].

An account is given of investigations in 1936–39 in the Niagara district of Ontario on the bionomics of *Macropsis trimaculata*, Fitch [*cf. R.A.E.*, A **26** 173], the Jassid vector of peach yellows [**23** 603] and little peach [**26** 385], which are of importance in this district. Its distribution in eastern Canada is reviewed from the literature, and all stages and the rearing technique adopted are briefly described.

During all three years, its preferred food-plant was wild plum (*Prunus americana*), but when infestation was general, it attacked both European and Japanese varieties of cultivated plum fairly heavily. It also breeds on peach to some extent, but was not observed on *P. serotina* or *P. virginiana* growing near infested plums. *P. americana* is too scarce in peach-growing districts to be of importance in harbouring it under normal conditions, but it persists on this food-plant in years when it is scarce elsewhere and cannot be found in the orchards. During 1936, it was common, though never abundant, on *P. americana* and in plum orchards in the Niagara Peninsula, and was also present on peach, but was scarce in 1937 and 1938, though in 1939 there were indications that the population was again increasing.

Hatching was observed in May and June and may occur at temperatures as low as 41°F. The duration of the nymphal stage averaged 53·8, 42·2 and 45·6 days in 1936, 1937 and 1938, respectively. The nymphs congregate on the twigs and small branches, usually at their junction with larger branches, or in crevices in the spurs or axils of the leaves. When about to moult they migrate to the foliage. The adults occur in similar situations, and in hot weather gather on the

lower surface of the leaves on the shaded side of the tree. On warm days they may fly if disturbed. Feeding takes place on the young twigs and to some extent on the petioles, and the punctures may eventually give rise to lenticel-like structures, but it is unlikely that any direct injury results either to plum or peach, since the populations in orchards are never large. Mating took place 2–49 days after the females had matured. The largest number of viable eggs deposited by a single female was 57. In 1937, adults survived for 2 months on potted plum, but all were dead by 6th September.

A closely allied species, *M. insignis*, Van Duzee, occurred on *P. americana* at a few points in 1938 and was very abundant at one of them in 1939. Its bionomics resemble those of *M. trimaculata*.

Maxwell (C. W. B.) & Lord (F. T.). **Notes on** *Lampronia rubiella*, **Bjerk. a Raspberry Pest new to North America.**—*Rep. ent. Soc. Ont.* **70** (1939) pp. 49–51, 1 ref. Toronto [1940].

Incurvaria (*Lampronia*) *rubiella*, Bjerk., which was found in a raspberry plantation near Fredericton, New Brunswick, in 1936 [*R.A.E.*, A **28** 283], was taken in the early summer of 1939 at several points along a distance of 70 miles in the St. John River Valley and also in Prince Edward Island. Of the two varieties of raspberry grown in the originally infested plantation, only one was attacked, and this variety was the one most frequently attacked elsewhere; wild canes were also occasionally infested. In the original plantation, where this Tineid is believed to have been present for at least two years before 1936, infested canes were stunted in growth and the foliage was poorly developed. The only injury caused is that by the overwintered larvae to the buds.

It is thought that the larvae hibernate in the surface soil or débris, since some were observed on 9th May 1939 on the soil and on stumps of overwintering canes that had been cut down in early spring and enclosed within a barrier, and others were present on the canes below adhesive barriers placed as near as possible to the base. They were first observed crawling on the canes on 26th April in 1938 and 9th May in 1939. A single larva attacks several buds before finally entering one, and later bores downwards in it, sometimes reaching the pith of the cane; it returns to pupate near the tip of the bud. The first pupae were found on 6th June in 1939, and the adults first appeared on 19th June in the insectary and 20th June in the field. Although eggs are stated by European workers to be deposited on the stamens [*cf.* **22** 668], none occurred on raspberry flowers on which adults had been caged, nor were larvae found there later. Newly-hatched larvae were feeding on 28th July in the receptacles of the fruit.

Preliminary experiments on control, in which sprays were applied to the soil, the bases of the canes or the green tips in the early spring of 1939, gave inconclusive results, though one containing 2 per cent. lubricating-oil emulsion oil and 4 per cent. dinitro-ortho-cyclohexylphenol, applied to the soil, showed some promise.

Baird (A. B.). **Biological Control of Insect Pests in Canada with special Reference to the Control of the European Spruce Sawfly** *Gilpinia polytoma* **Htg.**—*Rep. ent. Soc. Ont.* **70** (1939) pp. 51–56, 21 refs. Toronto [1940].

A brief review is given of some of the more important work carried out on the biological control of various pests in Canada since 1910.

More than 500 million parasites have been distributed from the Dominion Parasite Laboratory at Belleville, Ontario, during the ten years following its establishment in 1929 and of these over 450 million, comprising 18 species, have been released against the European spruce sawfly, *Gilpinia polytoma*, Htg. Two of the species parasitic on the latter have become established [*R.A.E.*, A **29** 38–39, etc.]. The need for the development of a satisfactory method of evaluating the results of parasite distribution and of the importance of parasites in the control of pests is pointed out.

SMITH (C. W.). **An Exchange of Grasshopper Parasites between Argentina and Canada with Notes on Parasitism of native Grasshoppers.**—*Rep. ent. Soc. Ont.* **70** (1939) pp. 57–62. Toronto [1940].

Collections of Diptera and Coleoptera that are parasitic or predacious on grasshoppers were made in Alberta, Saskatchewan and Manitoba, and Dipterous larvae were reared from caged grasshoppers in British Columbia, in an attempt to obtain natural enemies, particularly the Bombyliid, *Systoechus vulgaris*, Lw., the larvae of which are predacious on the eggs, and *Sarcophaga kellyi*, Aldr., which parasitises the older nymphs and adults, for dispatch to Argentina in exchange for parasites native to that country. In 1937, totals of 958 *Systoechus vulgaris*, 91 *Sarcophaga* spp., and 95 other larvae and pupae were obtained; the undetermined Dipterous larvae and pupae were roughly divided into groups, and the resulting adults were identified as *Sarcophaga hunteri*, Hough, *S. opifera*, Coq., *S. reversa*, Aldr., *S. coloradensis*, Aldr., *S. aculeata*, Aldr., *S. atlanis*, Aldr., the Nemestrinid, *Trichopsidea* (*Parasymmictus*) *clausa*, O.-S., and the Anthomyiid, *Hylemyia nidicola*, Aldr. Consignments of 770 examples of *Systoechus* and smaller ones of *Sarcophaga hunteri* and *S. opifera* were forwarded by air to Argentina in the winter of 1937 38, and further shipments of *Systoechus*, *Sarcophaga hunteri*, *S. aculeata* and *S. atlanis* were made in 1939. The first consignment arrived in good condition; and it was reported that *S. hunteri* developed successfully in species of *Trigonophymus* and *Scyllina*, but that no success was obtained with *S. opifera* and that larvae of *Systoechus* were not reacting well to handling. *Sarcophaga hunteri* also parasitised *Schistocerca paranensis*, Burm., from which, however, no mature larvae developed.

A shipment of 295 larvae of *Sarcophaga caridei*, Brèth., was despatched from Buenos Aires on 31st March 1938, and on arrival in Ontario 7 days later, 20 larvae were dead and 93 had pupated. Further consignments were received during 1939, one of which also contained an undetermined Sarcophagid, but the latter could not be propagated as only females emerged. Attempts to rear grasshoppers in the laboratory during 1937–38 were unsuccessful, and as insufficient hosts were available when the first parasites arrived, they were kept at a temperature of 38–42°F. until grasshoppers were present in the field. Small numbers were placed in incubators at a temperature of 73–75°F. between 12th May and 15th July 1938, and from these 72 males and 51 females were obtained. The adults mated readily in cotton covered cages at 72 74°F. and females readily larviposited on grasshoppers. The resulting larvae and pupae were stored overwinter, but only two males emerged in the spring of 1939, and further supplies of larvae had therefore to be obtained from Argentina. From 45 larvae and

pupae received on 19th June, 17 males and 13 females were reared. The females mate soon after emerging, and the periods of gestation and larval and pupal development lasted 7–10, 5–7 and 13–16 days, respectively, at 74°F. The larvae pass through three instars within the body of the host and emerge from it to pupate. The average number of larvae deposited by an individual female was 75, and the maximum 104. The longevity of mated females under laboratory conditions at 74°F. was 30–69 days. It was evident that three generations would occur in the field in Ontario during a year. *Camnula pellucida*, Scudd., was the most favourable host, and about 60 per cent. of the larvae deposited on it gave rise to adults. *Melanoplus mexicanus*, Sauss., *M. femur-rubrum*, DeG., and *Orphulella speciosa*, Scudd., were also satisfactory, but *M. bivittatus*, Say, was less so, and the larvae did not mature in *Dissosteira carolina*, L. One adult developed in *Gryllulus* (*Gryllus*) *assimilis*, F., which, however, was not suitable for laboratory propagation. On 11th September 1939, 24 mated females were released at each of two places in Ontario.

Studies were also made of natural enemies native to Canada, and a list is given of insect and other parasites and predators and disease organisms observed in the field or bred from hosts collected in Alberta, Saskatchewan, Manitoba, British Columbia or Ontario in 1937–39. Three secondary parasites were also obtained. *Systoechus vulgaris* appeared to be the species of most importance in the Prairie Provinces, and Sarcophagids in British Columbia. Laboratory studies indicated that *Sarcophaga reversa* and *S. aculeata* attack the grasshoppers in flight. *S. atlanis* deposits free larvae, whereas those of *S. hunteri* are enclosed in the chorion and are deposited between the abdominal segments. Larvae of *S. atlanis* removed from a gravid female quickly entered the host through a membranous area. An undetermined Dipterous parasite that was reared from *M. bivittatus* collected in Manitoba in 1938 is believed to belong to an undescribed genus ; it was found that the female punctures the body of its host with its mouthparts and oviposits in the opening thus made.

Observations were also made on the secondary parasite, *Perilampus hyalinus*, Say, which was obtained in collections from Ontario. It is known that the planidia or first-instar larvae of *Perilampus* are to be found in the bodies of insects likely to be selected by some primary parasite. If a *Perilampus* planidium and the larva of a Dipterous parasite are present in a host, the planidium enters the maggot and remains undeveloped until the maggot has formed a puparium. It then emerges from the maggot, feeds on it as an ectoparasite, and finally pupates in its puparium. There has been some speculation as to the manner in which *Perilampus* enters the host of the primary parasite. The observations on *P. hyalinus* showed that the eggs are laid on blades of grass and hatch in about 6 days at 74°F., after which the planidia wander slowly over the blades. Eggs and planidia that were swallowed by grasshoppers did not survive, but two planidia were observed to puncture the tarsal pads and enter in this way. Approximately 600 eggs were deposited by one female during 8 days.

McLeod (J. H.). **Biological Control of Greenhouse Insect Pests.**—*Rep. ent. Soc. Ont.* **70** (1939) pp. 62–68, 9 refs. Toronto [1940].

A list is given of 26 natural enemies of greenhouse pests in various parts of the world, and work done on their biological control is very

briefly reviewed. In Canada, the first attempt was made in 1928, when *Encarsia formosa*, Gah., was introduced from England against *Trialeurodes vaporariorum*, Westw., with such success that well over a million parasites were distributed throughout the Dominion and in Newfoundland in 1939. The biological control of Aphids was also successfully developed.

Following requests for parasites of mealybugs, a shipment of *Leptomastix dactylopii*, How., a parasite of *Pseudococcus citri*, Risso, was received in April 1937 from California, where it had been introduced from South America. A few weeks before this, mealybugs parasitised by *Leptomastidea* (*Tanaomastix*) *abnormis*, Gir., were found on a greenhouse plant in Ontario. This parasite is a species that had been introduced into the United States [*cf. R.A.E.*, A **20** 685]. Populations of both these Encyrtids were reared in the laboratory, and 42,425 and 5,790 adults of *Leptomastidea* and 15,905 and 84,585 of *Leptomastix* were distributed during the winters of 1937–38 and 1938–39, respectively. In 1937, an experimental shipment of adults of *Leptomastidea* was sent from Ontario to British Columbia and back by railway express to determine the effect of transport during severe winter weather. After covering more than 5,000 miles between 23rd December and 3rd January, 49 per cent. of the parasites were in good condition and, when liberated in a colony of unparasitised mealybugs, gave normal parasitism. The type of container in which the parasites are shipped was found to be of minor importance, but insulation from extremes of temperature and the provision of food (sugar or raisins) are necessary. Good control resulted from liberations of these parasites when *P. citri* was the only mealybug present. In one conservatory in which they were released, the percentage parasitism approached 90 three months later and over half of this was due to *Leptomastix*. Where unsatisfactory results were reported, the mealybug was found to be *P. maritimus*, Ehrh., and not *P. citri*, to which both parasites are specific. In California, *P. maritimus* is attacked by a number of native parasites [**12** 588], and a few individuals of the Encyrtids, *Zarhopalus corvinus*, Gir., and *Chrysoplatycerus splendens*, How., were collected there in 1939 and are being reared in the laboratory at Belleville.

The author concludes by reviewing the ways in which greenhouse conditions facilitate control by biological methods and the requirements that must be fulfilled if a natural enemy is to be successful under such conditions.

Wishart (G.). **Biological Control of the Pea Moth** *Laspeyresia nigricana* **Steph.**—*Rep. ent. Soc. Ont.* **70** (1939) pp. 68–72, 1 fig., 7 refs. Toronto [1940].

Late green peas and peas grown for drying are seriously damaged by *Cydia* (*Laspeyresia*) *nigricana*, Steph., in British Columbia, eastern Quebec, New Brunswick and Nova Scotia; plant infestation as high as 100 per cent. in peas grown for seed and pod infestation of 70 per cent. have been reported from British Columbia and Nova Scotia, respectively. With a view to the introduction of effective parasites from an area in which the moth is indigenous, a survey was carried out of the natural agents of control in England, the results of which have already been noticed [*R.A.E.*, A **27** 38].

In 1936, 1937 and 1938, consignments of 28,500, 30,000 and 27,000 cocoons of *C. nigricana*, some of which were parasitised by *Ascogaster*

quadridentata, Wesm., *Glypta haesitator*, Grav., and *Angitia* sp., were sent to Ontario, where they arrived in late August or September and were kept in cool storage in the original containers. A temperature of about 36°F. was the most satisfactory for storage, since development was not sufficiently retarded at higher temperatures, the results were less satisfactory at 32°F. and the percentage mortality was 95 at 20°F. Unparasitised larvae were less seriously affected by adverse storage conditions than those containing parasites. Much better emergence of both host and parasites (58·2 per cent.) was obtained when the cocoons were kept on moist blotting paper on the floor of small wooden boxes with sliding glass tops than when they were buried under a $\frac{1}{2}$ in. layer of damp sand (1·1 per cent.). The adult parasites were kept in cotton cages, and were despatched in copper screen cans containing moist excelsior by air or by railway express, when the cans were placed in refrigerators. In most cases they arrived in good condition.

The numbers of parasites liberated in British Columbia in 1937, 1938 and 1939 comprised 65, 880 and 4,377 of *Ascogaster*, 12, 734 and 809 of *Glypta*, and 0, 5 and 21 of *Angitia*; 900 and 392 of *Ascogaster* and 10 and 279 of *Glypta* were released in Nova Scotia in 1938 and 1939, with 21 of *Angitia* in 1939, while 379 of *Glypta* were liberated in Quebec in 1938. The development of the host in Quebec was retarded by climatic conditions in 1939, and no parasites were available when it was in the right stage for attack. In British Columbia, *G. haesitator* has been recovered in sufficient numbers to offer prospects of establishment.

Stultz (H. T.). **Methods and Materials of a new Technique for using Pomace Flies in Biological Tests with Contact Insecticides.**—*Rep. ent. Soc. Ont.* **70** (1939) pp. 72–80, 4 figs. Toronto [1940].

An account is given of a technique for rearing *Drosophila melanogaster*, Mg., and *D. hydei*, Sturt., and using the adults for tests of contact insecticides. Descriptions are given of the culture medium employed; the oviposition and rearing cages; the lantern-globe spray chamber; the spraying apparatus, which consists of an atomiser, an air pump run by an electric motor, an air tank fitted with a device for maintaining constant air pressure, and a pressure gauge; and the methods of transferring the flies from one rearing cage to another and to the spray chamber, applying the spray, and recording the results.

Gobeil (A. R.). **The Classification of Forest Insect Injury.**—*Rep. ent. Soc. Ont.* **70** (1939) pp. 88–92, 2 refs. Toronto [1940].

The methods employed by the Quebec Entomological Service in organising annual surveys of forest insects and for estimating the damage due to them are very briefly described. Information is derived from samples, chiefly of larvae, collected by fire-rangers [*R.A.E.*, A **27** 463], and also from data obtained by survey parties engaged on such activities as general line surveys of the forests. As these parties do not as a rule include a trained entomologist, a form on which can be entered the minimum amount of information to be recorded has been devised for their use and is here reproduced and discussed. It is proposed to supplement these sources of information by data collected by trained forest entomologists from some of the permanent sample plots already established in the Province.

MORLEY (P. M.). **Some Possibilities in Control of the Pine Sawyer Beetle by Chemical Methods.**—*Rep. ent. Soc. Ont.* **70** (1939) pp. 93–95, 2 refs. Toronto [1940].

In Canada, Lamiids of the genus *Monochamus* oviposit in crevices or excavations in the bark of recently cut pine logs in spring or early summer, and the larvae, which tunnel into the wood 4–6 weeks after hatching and require 2 or 3 seasons to complete their development, cause serious depreciation in the quality of the timber. The problem becomes acute when an early thaw results in many piles of logs being left in the bush during the summer. Oviposition can be prevented by barking the logs or by flotation in water, but this necessitates rehandling and redecking. The value of sprays, including repellents and stomach insecticides, to destroy the adults and contact insecticides capable of penetrating the wood and destroying the young larvae, were therefore tested, and the properties required in both types of insecticide are briefly discussed.

Small piles, each containing 15 logs 4 ft. long and with an average diameter of 6 ins., were used in the experiments. Each pile received 2 gals. spray, and particular attention was paid to the sides, undersides and ends of the logs, where attack by *Monochamus* is usually concentrated. The degree of control was estimated from counts of living and dead larvae in three logs from each pile. Of the repellents and stomach poisons, including arsenicals, fluorides, fluosilicates, tar derivatives, lime and sulphur, that were tested, alone and in combination and, where possible, both as dusts and sprays, only a combined spray containing lime-sulphur and sodium arsenite was effective; this result was confirmed in the following season, when logs treated with lime-sulphur and sodium arsenite in various combinations were only very slightly infested 10 weeks later, containing an average of 2 larvae per log, compared with 27 in the controls, and the attack appeared to be of recent occurrence.

In view of work by K. A. Salman [*R.A.E.*, A **26** 394], the sprays tested for killing the young larvae consisted of various penetrating oils in combination with tar derivatives or simple organic compounds. Many of these sprays were effective, including two containing fuel oil with naphthalene or with crank-case oil and creosote. The percentage mortality was highest when spraying was carried out on hot days. The standard bush fire-fighting equipment was successfully employed for applying the sprays in commercial trials.

BARNES (H. F.). **Studies of Fluctuations in Insect Populations. VII. The Button Top Midge** (*Rhabdophaga heterobia*) **at Syston, 1934–39.** —*J. Anim. Ecol.* **9** no. 2 pp. 202–214, 4 figs., 4 refs. London, 1940.

The following is largely the author's summary. This study of *Rhabdophaga heterobia*, H. Lw., in a field of commercially grown willow (*Salix triandra*) in Leicestershire is a continuation of the third study in the series [*R.A.E.*, A **23** 153], which covered the years 1928–33, and contains the data for the years 1934–39 and a review of the results obtained during the whole period.

The changes in the combined population of *R. heterobia* and its parasites are discussed. Birds, especially tits, are shown to play an important part in reducing the total population during the winter

months [*cf.* **17** 405]. A drop in 1930 was probably caused by a drought in the late summer of 1929, and the hot summers of 1933 and 1934, acting through plant growth, caused similar reductions in 1934 and 1935. Since 1936, the population has steadily fallen because the cultivation of the willows was discontinued in that year, and they have since been exterminated as a result of grazing.

A positive correlation was found between the numbers of *R. heterobia* and of its parasites, but there is no correlation between the size of the combined population and the percentage parasitism. The percentage changes from year to year in the numbers of the combined population and in those of the parasites were almost identical. The absolute number of parasites did not appear to lag behind that of the host, but observations were made only on the third generation of the latter. Relative parasitism as high as 64 per cent. exerts no control on the host; the parasites do not become more efficient at high population levels than at low ones and so cannot have any balancing effect. In addition to the six parasites already recorded [**23** 154], a predacious Cecidomyiid, *Lestodiplosis* sp., was reared in small numbers.

R. heterobia and its parasites emerge readily in response to increased warmth in March. Under normal conditions, the dates of the first appearance of *R. heterobia* varied from 13th April to 16th May, but the weeks of peak emergence showed less variation. The emergence of the parasites usually follows closely that of the host, but in some years the weather appears to act differentially on host and parasites as regards dates of emergence.

RICHARDS (O. W.). **The Biology of the Small White Butterfly** (*Pieris rapae*), **with special Reference to the Factors controlling its Abundance.**—*J. Anim. Ecol.* **9** no. 2 pp. 243–288, 16 refs. London, 1940.

This paper, which comprises an account of investigations carried out at Slough (Buckinghamshire) in 1932–36, is in two main sections, the first on the general biology of *Pieris rapae*, L., and the second, which is about three times as long, on the factors controlling its abundance. Characters distinguishing the immature stages of the four commoner Pierines that occur on crucifers in England are given, and the food-plants on which they were found at Slough are recorded. Cabbage was the most important food-plant of *P. rapae*, but it occurred on all but two of the common wild and cultivated crucifers. The rest of the section on its general bionomics comprises a discussion of oviposition and pupation sites, the duration of the stages at different temperatures, the sex ratio, the number of generations per year, and the factors determining hibernation (pupal diapause). In 1934, there were three complete generations, which the author believes to be normal, and in most years there was a partial fourth; under laboratory conditions in 1932, six generations were obtained.

The study of the fluctuations in numbers was based on egg counts and on collections of larvae and pupae; the methods are described and their limitations discussed. Mean temperatures between 15·55 and 16·66°C. [about 60 and 62°F.] associated with a mean weekly rainfall of 7·5–12·5 mm. appear to be favourable. The observations recorded suggest that Arthropod predators have no significant effect on the number of *P. rapae*, except on wild crucifers, but birds appear

to be of moderate importance in destroying the pupae. About 1·3 per cent. of the eggs failed to hatch in the field and were probably sterile ; no egg parasites were observed. Mortality of larvae and pupae due to wilt disease was considerable in the laboratory, but is probably less under field conditions. Insect parasites comprised the Braconids, *Apanteles rubecula*, Marsh., and *A. glomeratus*, L., and the Tachinids, *Zenillia* (*Phryxe*) *vulgaris*, Fall., *Z.* (*P.*) *nemea*, Mg., an unidentified species of the same genus, *Epicampocera succincta*, Mg., and *Compsilura concinnata*, Mg., all of which attack the larvae, and the pupal parasite, *Pteromalus puparum*, L. About half the paper is devoted to an account of their bionomics, natural enemies and effect on the population density of *Pieris rapae*, but only the first three, which are the most important, are dealt with in detail. The percentage parasitism by *A. rubecula* was 24·1, and observations and experiments established that it is influenced by the site of the food-plant, as well as by host density, since it was twice as great on cabbages growing close together in sheltered situations (garden conditions) as on those growing farther apart and in more exposed situations (field conditions). The percentage parasitism by *A. glomeratus* was 3·4 ; this parasite normally attacks *P. rapae* only when *P. brassicae*, L., which is its main host, is also present, and has failed to become established in New Zealand, where *P. brassicae* does not occur [*R.A.E.*, A **28** 28]. Both species of *Apanteles* were parasitised by the Eulophid, *Tetrastichus rapo*, Wlk., and the Ichneumonids, *Mesochorus tachypus*, Hlmgr., and *Hemiteles* (*Astomaspis*) *nanus*, Grav. (*fulvipes*, Grav.), while *H.* (*A.*) *submarginatus*, Bridgm., was obtained from *A. rubecula* and *H. areator*, Panz., from *A. glomeratus*. The first two were the most important, the others being uncommon. The inter-relations between the different species of parasites and between the hosts and their parasites are discussed. The factors studied in this investigation are responsible for the destruction of 264 individuals from the average of 350 eggs deposited by a single female of *P. rapae*. The remaining 84 that must be destroyed if there is to be no increase in numbers are probably eaten by birds and other predatory enemies of the pupae and fifth-instar larvae.

Jones (D. P.). **Oviposition in Gall Midges (Cecidomyidae) affecting Seed Production in Grasses.**—*J. Anim. Ecol.* **9** no. 2 pp. 328–335, 1 fig., 9 refs. London, 1940.

An account is given of investigations carried out in Wales in 1936 on the oviposition of Cecidomyiids that affect seed production in grasses. The work was mainly confined to *Contarinia merceri*, Barnes, on *Alopecurus pratensis*, but its oviposition cycle is believed to be characteristic of most species of *Contarinia* that affect seed production in allied grasses. Oviposition by it exhibited a marked diurnal periodicity and occurred chiefly between 5 p.m. and 8 a.m. (Greenwich Mean Time), with a peak shortly before sunset and another shortly after sunrise. It was very much influenced by the intensity of light, shade being preferred, and was inhibited by wind velocities exceeding 10 miles an hour at a height of 50 ft. Contrary to expectations, it did not appear to be related to the time of flowering of the food-plant.

A similar oviposition cycle was observed in *C. dactylidis*, H. Lw., on *Dactylis glomerata*, in which also there was no correlation between the oviposition peak and the flowering time of the grass. Observations

made on a single occasion in Montgomeryshire indicated that *C. lolii*, Metcalfe, on *Lolium perenne*, *Dasyneura dactylidis*, Metcalfe, on *Dactylis glomerata*, *Contarinia* sp. on *Holcus lanatus*, and *Sitodiplosis cambriensis*, Jones [see next abstract] on *Poa pratensis* and *P. trivialis* have a definite oviposition peak in the evening but not in the morning, although all these species except *C. lolii* continued to oviposit until well after daybreak. Other examples of periodicity in oviposition, notably in *C. tritici*, Kby., and *S. mosellana*, Géh., are briefly reviewed from the literature.

Jones (D. P.). **Gall Midges (Cecidomyidae) affecting Grass-seed Production in Mid-Wales and West Shropshire, together with Descriptions of two new Species.**—*Ann. appl. Biol.* **27** no. 4 pp. 533–544, 7 refs. London, 1940.

Observations on the species of Cecidomyiids that affect seed-production in grasses of economic importance were carried out in mid-Wales and Shropshire during 1934–36 [*cf. R.A.E.*, A **24** 795], and the results are summarised in this paper, which contains notes on the abundance of 20 species attacking 10 species of grasses and on the bionomics of some of them. Eleven species are believed to be new to science, and two of these, which infest *Festuca* spp. and *Poa* spp., respectively, are described as *Contarinia festucae* and *Sitodiplosis cambriensis*. Both are potentially of economic importance. The principal species is *C. merceri*, Barnes [see preceding abstract], which attacks *Alopecurus pratensis* and is dealt with at greater length than the rest ; others of economic importance include *C. dactylidis*, H. Lw., and *S. dactylidis*, Barnes, on *Dactylis glomerata*. Keys are given to the Cecidomyiid larvae found on the various grasses, including those of the predacious genera *Lestodiplosis*, *Arthrocnodax* and *Bremia*.

Fisher (R. C.). **Studies of the Biology of the Death-watch Beetle, *Xestobium rufovillosum* De G. III. Fungal Decay in Timber in Relation to the Occurrence and Rate of Development of the Insect.**—*Ann. appl. Biol.* **27** no. 4 pp. 545–557, 10 refs. London, 1940.

Details are given of investigations in England on the effect of decay by fungi on the suitability of oak, willow and other timber under different conditions of temperature and humidity for infestation by *Xestobium rufovillosum*, DeG., some of the results of which have already been noticed from other sources [*R.A.E.*, A **28** 452 ; **29** 178]. In sound willow, the progress of attack was very slow, and in an apparently sound sample that showed traces of decay in parts, larvae were still living but less than half developed after 9½ years. In willow, severely decayed throughout by *Coniophora cerebella*, development was completed in only 10–17 months at temperatures of 22–25°C. [71·6–77°F.] and 80–90 per cent. relative humidity. Results similar to those given for oak sapwood [**28** 452] were obtained with oak heartwood, which was not attacked when sound but which, when severely decayed by *Phellinus cryptarum*, was as susceptible as decayed sapwood, the apparent preference for sapwood being due to its greater liability to fungous decay. Tests with banak (*Virola merendonis*), a non-durable hardwood from British Honduras, confirmed the conclusion that severely decayed hardwoods are particularly suitable for attack. Scots pine (*Pinus sylvestris*) and Sitka spruce (*Picea sitchensis*), even

when severely decayed, were less suitable. Undecayed balsa (*Ochroma* sp.), which, owing to its low density, might be expected to offer only slight resistance to larval boring, was also unsuitable.

The paper also contains a list of the fungi found in decayed oak and willow trees, which are the natural habitat of *X. rufovillosum* ; notes on eight species of fungi, mostly wood-destroying species causing brown or white rots, that have been identified from infested timbers ; and a discussion of the bearing of the relation between fungous decay and *X. rufovillosum* on the spread of infestation in buildings.

Menozzi (C.). **Parassiti e predatori del** *Conorrhynchus mendicus* **Gyll. (Coleoptera-Curculionidae) dannoso alla bietola da zucchero in Italia, e loro importanza nella lotta biologica contro questo fitofago.** [The Parasites and Predators of *Cleonus mendicus* and their Importance in the biological Control of this Pest of Sugar-beet in Italy.]—*Verh. 7 int. Kongr. Ent., Berlin 1938* **4** pp. 2561–2575, 2 charts, many refs. Weimar, 1939. [Recd. 1941.]

The author gives charts illustrating the life-cycle of *Cleonus* (*Conorrhynchus*) *mendicus*, Gylh., which is a serious pest of sugar-beet in Italy, and an account of the results of observations, made over a period of several years, on its natural enemies. These include several predators [*cf. R.A.E.*, A **18** 561], but the most important is the parasite, *Rondania cucullata*, R.-D. [*cf.* **26** 527, etc.], which attacks the adults. This Tachinid overwinters in the pupal stage, which is passed in the soil. The adults emerge in April, and there are two generations a year, of which the first develops in *C. mendicus* and *Brachycerus undatus*, F., and the second, which is present from June onwards, in *Larinus* spp. [*cf.* **19** 461] and possibly other weevils. Females deposit about 40 eggs, usually placing 2 in the anal aperture of each host [*cf.* **17** 633]. The eggs hatch in 8–10 hours, and the larval and pupal stages last 23–25 and 12–15 days, respectively. The percentage parasitism is variable, but in 1935 it reached 60–65 in one district. A few of the larvae of *C. mendicus* are parasitised by the Tachinid, *Zeuxia cinerea*, Mg. [*cf.* **26** 527], only one larva of which occurs in each host. The larvae become full-fed in about a month and pupate in the cells constructed by the host larvae, and the adults emerge in 12–15 days. Adults were seen in June in the beet-fields. A third parasite is the Nematode, *Neoaplectana menozzii*, Travassos. It has three generations a year and overwinters in the egg stage in the soil. All three can develop in the soil, but most of the larvae of the first generation enter the larvae of *C. mendicus*, through the anal aperture. These individuals reproduce parthenogenetically, giving rise to males and females that develop in the dead host. If the host larva is already advanced in development, parasitism continues in the pupa and even in the adult. The total percentage parasitism does not exceed 8–10, but in the patches where the Nematode was present, all the examples of *C. mendicus* were parasitised.

Celino (M. S.). **Experimental Transmission of the Mosaic of Abacá, or Manila Hemp Plant** (*Musa textilis* **Née**). —*Philipp. Agric.* **29** no. 5 pp. 379–403, 5 pls., 46 refs. Los Baños, P.I., 1940.

Mosaic of Manila hemp (*Musa textilis*), which is caused by the virus known as *Marmor cucumeris* in the system of nomenclature of Holmes

(*Cucumis* virus 1), is spreading with increasing severity in the Province of Davao on the island of Mindanao, but does not occur in other parts of the Philippines where *M. textilis* is grown. Observations by Calinisan indicated that *Pentalonia nigronervosa*, Coq., might be the vector [*R.A.E.*, A **27** 365 ; *cf.* also **29** 57], but in experiments by Ocfemia and the author in 1937–38 this Aphid did not transmit the virus, whereas it was readily transmitted by *Aphis gossypii*, Glov., and two other Aphids, not only to *M. textilis* but also to wild *Canna indica*. A mosaic of wild *Canna* possibly caused by the same virus is prevalent in Davao. The symptoms of the disease in *M. textilis* are discussed from the literature, and observations are recorded on its early stages. Infected plants are more or less stunted and produce slender pseudo-stems of little or no commercial value ; finally, the roots become weakened and are readily attacked by fungi and bacteria.

An account is given of some of the author's experiments during 1937–40, in which the virus was not transmitted to healthy *M. textilis* by *P. nigronervosa*, *Stephanitis typica*, Dist., or *Ferrisiana* (*Ferrisia*) *virgata*, Ckll., or by various mechanical methods. It was readily transmitted, however, from infected to healthy *M. textilis* by large batches of *A. gossypii* and *Rhopalosiphum nymphaeae*, L., the incubation periods in the plants ranging from 13 to 25 and from 8 to 23 days, respectively. In tests with smaller batches of *R. nymphaeae*, the virus was transmitted to 2 of 21 healthy seedlings by the feeding of 8 Aphids, but the incubation periods were 57 and 60 days, and plants infested with batches of 5 and 3 Aphids all remained healthy. When the Aphids were allowed to feed for periods of 1–48 hours on infected plants and then transferred in batches of 50 to healthy ones, some of the latter were infected by Aphids that had fed for 2 or more hours on the diseased source. The acquisition of the virus from a diseased plant and its introduction into a healthy one was accomplished by *R. nymphaeae* in 3–4 hours. The Aphids did not, however, retain the virus for long, and when transferred from diseased plants to a series of healthy ones, transmitted it to two successive plants in only one of ten experiments. Females of *R. nymphaeae* did not transmit the virus to their offspring. The mechanism of the transmission of the virus by *R. nymphaeae* and *A. gossypii* is described ; it was found that the stylets of both Aphids penetrate young leaves of *M. textilis* either through the stomata or directly through the lower epidermis and reach the phloem by passing between or occasionally through the cells.

In investigations on host range, the virus was transmitted by *R. nymphaeae* from *M. textilis* to *C. indica* (with incubation periods of 9–20 days), but not to *C. edulis* or two unidentified species of *Canna*, and neither Aphid transmitted it to cotton, *Hedychium coronarium* or four varieties of banana. The virus is considered identical with that of infectious chlorosis of banana in Australia [*cf.* **29** 57], and this failure to transmit it to Philippine bananas is attributed to the fact that the Aphids were unable to gain a foothold on the plants and so were unable to feed.

The virus of bunchy top, *Marmor abacá* (*Musa* virus 2), which is transmitted by *Pentalonia nigronervosa* [*cf.* **22** 658], was not transmitted from diseased to healthy *M. textilis* by large batches of either *R. nymphaeae* or *A. gossypii*, and it is suggested that there may be a definite and specific relationship between this virus and *P. nigronervosa*.

VAN DER LAAN (P. A.). **Motschildluis en *Eupatorium* als oorzaken van pseudo-mozaiek.** [Whitefly and *Eupatorium* as Causes of Pseudo-Mosaic.]—*Vlugschr. Deli Proefst. Medan* no. 67, 4 pp. Medan, 1940.

Proof that the virus of pseudo-mosaic (pseudo-peh sim) of tobacco in Sumatra is transmitted by insects was obtained by uprooting infected tobacco plants and replacing them with seedlings free from disease and enclosing some of these in insect-proof cages. The caged plants did not become infected, but some of the others did.

Bemisia tabaci, Gennadius, was shown to be a vector by placing infected weeds together with healthy tobacco seedlings in cages free from this Aleurodid, which was then introduced. In 2–3 weeks pseudo-mosaic appeared on the tobacco, from 20 to 30 per cent. of the seedlings usually becoming infected. Tobacco plants caged with either the Aleurodid or infected weeds, but not both, remained healthy. *B. tabaci* also transmitted kroepoek disease [*cf. R.A.E.*, A **22** 379]. Two weeds, *Ageratum conyzoides* and *Synedrella nodiflora*, both known reservoirs of the virus of kroepoek [*cf. loc. cit.*], were found infected with pseudo-mosaic, and in one instance, *Stachytarpheta dichotoma* was also infected. It has been observed that *Eupatorium odoratum* has of recent years become increasingly common in the neighbourhood of infested tobacco and that nymphs of *B. tabaci* are common on it. This weed shows indistinct symptoms of virus disease, and when affected plants were caged with healthy tobacco and *B. tabaci*, some of the tobacco plants developed symptoms of pseudo-mosaic. Tobacco caged with *B. tabaci* and healthy *E. odoratum* was not affected. It is therefore concluded that *E. odoratum* is also a reservoir of the virus, and this plant should consequently be cleared away wherever possible. The clearing of strips about 100 ft. wide has proved inadequate in many cases, apparently because *B. tabaci* can be carried several hundred yards by wind.

VAN DER LAAN (P. A.). **Dierkundige Afdeeling.** [Zoological Section.] —*Meded. Deli Proefst.* (3) no. 7 pp. 52–59. Medan, 1940.

An account is given of work on the commoner insect pests of tobacco in Deli, Sumatra, in 1939. The tests with derris sprays against Aphids [*Myzus persicae*, Sulz.] made in 1938 [*R.A.E.*, A **28** 51] were not continued owing to the lightness of the infestation, but the effect of the spray on the quality of the tobacco was examined. No differences in the appearance of the leaf were observed, and aroma and taste were affected only if the spray also contained soap. In field tests of dusts against Lepidopterous larvae, derris and pyrethrum appeared to be less effective than barium fluorisilicate ; 5 per cent. lead arsenate was superior to 6 per cent. barium fluosilicate but slightly inferior to 8 per cent. barium fluosilicate ; and three kinds of local earth proved equally satisfactory as diluents.

Plots of 200 tobacco plants were enclosed by vertical screens 6·6, 8·4 and 10 ft. high. These appeared to prevent infestation by Aphids, but not the entry of moths, Capsids, or (except when 10 ft. high) the grasshoppers, *Valanga nigricornis*, Burm., and *Phaneroptera brevis*, Serv. The fact that insecticides used against Aphids are also effective against Capsids was confirmed by a considerable reduction

in the numbers of *Engytatus tenuis*, Reut., produced by the application of a spray containing 0·2 per cent. derris powder (of 10 per cent. rotenone content) and 0·1 per cent. soap.

A Galerucid of the genus *Craniotectus* was the chief insect pest attacking a plantation of *Derris*.

VAN DER LAAN (P. A.). **Onderzoekingen over de levenswijze der tabaksrupsen.** [Investigations on the Biology of Lepidopterous Pests of Tobacco.]—*Meded. Deli Proefst.* (3) no. 8, 47 pp., 35 refs. Medan, 1940. (With a Summary in English.)

The Lepidoptera that are injurious to tobacco in Deli, Sumatra, are *Heliothis assulta*, Gn., *Plusia signata*, F., *Prodenia litura*, F., *Psara ambitalis*, Rebel, and *Gnorimoschema* (*Phthorimaea*) *heliopa*, Lw., the first three being the most important. In this district the tobacco fields are planted only once in 8 years, seven-eighths of the land lying fallow, and the larvae develop on wild tobacco and other plants in this fallow ground. Of the larvae of the genus *Heliothis* collected on tobacco, 96 per cent. were *H. assulta* and 4 per cent. *H. armigera*, Hb. (*obsoleta*, F.), which is also very common on plants in fallow land. *Plusia signata* is the only species of its genus taken on tobacco, though three others occur on weeds, including *P. chalcites*, Esp., which has once been reared from young plants of wild tobacco.

Laboratory investigations on the life-history showed that the egg, larval and pupal stages required 3–5, 12·5 and 10–11 days for *H. assulta*; 3, 14 and 6 for *Plusia signata*; 3, 15 and 9 for *Prodenia litura*; and 4–5, 14 and 7 for *Psara ambitalis*. Development of *G. heliopa* lasts about a month. During a tobacco season, there appear to be 3 generations of *Plusia signata* and 2 of *Heliothis* and *Prodenia*. All stages of the three species occur throughout the year.

The results of field and laboratory investigations on food-plants other than tobacco are given in detail for each of the five injurious species. The larvae live only on young growth, occurring mainly on annual weeds, but also on perennials and seedling shrubs, where the bush has been recently cleared and burned in preparation for tobacco cultivation. The only alternative food-plant of *H. assulta*, besides wild tobacco, was *Physalis angulata*, which should be destroyed, not only for this reason, but also because it is one of the chief reservoirs of the virus of ordinary tobacco mosaic (peh sim). *Gnorimoschema* has also been taken on only one plant other than wild tobacco, but the other species were highly polyphagous. The practicability of clearing fallow land of weeds is discussed, and it is concluded that such land should be inspected by trained observers. If infestation is serious, the plants on such land should be cut down and burned, particularly during the period from December to February, before the tobacco is planted out.

RAMAKRISHNA AYYAR (T. V.). **The Bionomics of the Yam Beetle (*Galerucida bicolor* (Hope)) a Pest of cultivated Yam in S. India.**—*J. Bombay nat. Hist. Soc.* **41** no. 4 pp. 874–876, 1 pl., 5 refs. Bombay, 1940.

Descriptions are given of all stages of *Galerucida bicolor*, Hope, which occurs throughout India and attacks the cultivated elephant yam (*Amorphophallus campanulatus*). The adults feed on the leaves, and

the larvae, which are gregarious, skeletonise them completely and later gnaw into the leaf stalks and the main stem. The eggs are laid in clusters in the soil near the plants. In South Malabar, breeding begins with the rains in late May or early June, when the plants are sprouting, and the larvae appear about mid-June. A month later they are full-fed and enter the soil to pupate. The pupal stage lasts about a fortnight. If the rains continue up to the end of July, a large second generation occurs in mid-August, but after this the beetles disappear, possibly because they enter hibernation. This Galerucid is not a serious pest unless the season is favourable and the first generation is allowed to develop unchecked. In view of the gregarious habits of the larvae, they can be easily controlled by hand-picking or shaking them off the infested leaves into a pan of water ; hoeing the soil round the plants in July will destroy the pupae.

LOUNSBURY (C. P.). **The Pioneer Period of Economic Entomology in South Africa.**—*J. ent. Soc. Sthrn Afr.* **3** pp. 9–29. Pretoria, 1940.

The author briefly surveys the development of the organisation of entomological work in South Africa from 1895, when, following the introduction, possibly on vines from England, of *Phylloxera* [*vitifoliae*, Fitch] into Cape Colony and the successful control of the dorthesia [*Icerya purchasi*, Mask.] on *Citrus* by the Coccinellid *Rodolia cardinalis*, Muls.] imported from California, he became the first full-time entomological officer there, until 1920. In addition to notes on the holders of various entomological appointments, the subjects discussed include plant pest legislation and work on the control of locusts.

HESSE (A. J.). **A new Species of *Triphleps* (Hemiptera-Heteroptera, Anthocoridae) predaceous on the Citrus Thrips (*Scirtothrips aurantii* Faure) in the Transvaal.**—*J. ent. Soc. Sthrn Afr.* **3** pp. 66–71, 1 fig., 8 refs. Pretoria, 1940.

Lists are given of the species of *Orius* (*Triphleps*) that have been recorded from Africa and those that have been recorded as predacious on insects in other parts of the world, and the adults of both sexes of *O.* (*T.*) *thripoborus*, sp. n., are described from the Transvaal. This Anthocorid is stated by E. C. G. Bedford to be predacious on *Scirtothrips aurantii*, Faure, on *Citrus* and has also been taken on leaves of peach and *Acacia*.

LAVOIPIERRE (M. M. J.). *Hemitarsonemus latus* (**Banks**) (**Acarina**), **a Mite of economic Importance new to South Africa.**—*J. ent. Soc. Sthrn Afr.* **3** pp. 116–123, 2 figs., 7 refs. Pretoria, 1940.

Tarsonemus (*Hemitarsonemus*) *latus*, Banks, all stages of which are described, is recorded for the first time from South Africa, where it is firmly established in and around Durban (Natal) and is locally known as the dahlia mite. Its food-plants and distribution are very briefly reviewed from the literature, and a list is given of the 23 plants on which it has been taken in South Africa. Those most severely infested are beans, dahlias, castor (*Ricinus communis*), *Nicandra physaloides*, *Datura stramonium* var. *tatula* and *Bidens pilosa*. The injury consists in a browning and necrosis of the leaf, which gradually puckers up. The mites live gregariously, chiefly on the lower surfaces of the leaves,

and breed throughout the year, though there is a marked decrease in reproductive activity in winter. The egg, larval and nymphal stages last 3–4, about 2 and 1–2 days, respectively, in winter, but in summer development is probably completed in 4 days. The eggs are laid singly at the rate of 1–3 a day in winter and 5–6 in summer, and are deposited in small depressions on the surface of the leaves. The larvae and adults are active. The author has frequently observed adult males bearing female nymphs on the extremity of the genital papilla, and as adult females have not been observed to pair with males, it is suggested that the females are fertilised in the nymphal stage.

Large numbers of the mites are destroyed by summer rains, and some of the larvae are killed by a predacious Gamasid, but the latter is not very abundant. Satisfactory control has been obtained by dusting with sulphur, or spraying with 1 per cent. lime-sulphur or 1 per cent. nicotine, the treatment being repeated 3–4 days later.

Oosthuizen (M. J.) & Laubscher (F. X.). **The Cowpea Weevil.**— *J. ent. Soc. Sthrn Afr.* **3** pp. 151–158, 2 graphs, 7 refs. Pretoria, 1940.

Stored cowpeas in South Africa are severely infested by a Bruchid that was first observed there in 1937. It has been variously identified as *Bruchus analis*, F. [*R.A.E.*, A **28** 191] and *B.* (*Callosobruchus*) *marshalli*, Pic [and also recorded as *B. chinensis*, L. [**29** 58], of which *B. marshalli* is possibly a variety and which was long ago known to occur in South Africa (**7** 258)]. Apparently all varieties and strains of cowpeas are attacked. There are six generations from September to May and a possible seventh during the winter. The duration of the life-cycle varies considerably with temperature ; in February it is completed in about a month. At a mean temperature of 55 and a constant temperature of 86°F., the preoviposition period lasted 4–7 days and 2–24 hours, respectively. Females survived for an average of approximately 4, 6 and 20 days at 86, 77 and about 54°F., respectively, the corresponding average total numbers of eggs laid per female being about 51, 61 and 33. The percentages of eggs that hatched averaged 95 at 77°F. and 23·5 at about 54°F. The egg, larval and pupal stages lasted 6, 20 and 7 days, respectively, at 77°F., and 4, 15 and 5 days at 86°F. The eggs hatch in about 8 days in March, but require at least 33 days in May and June. Oviposition occurs not only on the stored seed but also in the field on pods in all stages of development and on seeds in split pods ; the severity of field attack largely depends on the number, extent and proximity of sources of infestation [*cf.* **29** 59]. It has been observed, however, that the percentage of eggs that give rise to adults is much lower on young pods than on yellow and ripe ones.

In experiments in which cowpea seeds were each artificially infested with 1–4 eggs and groups of 100 seeds were weighed before the larvae hatched and then at intervals of 3 days until the emergence of the adults, the loss in weight increased with the number of larvae present in the seeds, the final percentage loss being 11, 18·5, 26·5 and 36·5 for seeds infested with 1, 2, 3 and 4 eggs, respectively. The germinating capacity of seeds similarly infested was seriously reduced after 12 days in the case of those infested with 3 or more eggs, and after 18 days in the case of those with 1 or 2 eggs. Many of the seeds, including some that were apparently uninjured, gave rise to weak or abnormal plants.

LAWRENCE (R. F.). **A Note on some Mite Parasites of** *Locusta migratoria migratorioides* **R. & F.**—*J. ent. Soc. Sthrn Afr.* **3** pp. 173–178, 7 refs. Pretoria, 1940.

Caloglyphus julidicolus, Lawrence, a Tyroglyphid originally described in 1939 as a parasite of a millepede in the Transvaal, caused a heavy but probably adventitious infestation of *Locusta migratoria migratorioides*, R. & F., bred in cages in Pretoria ; hundreds of deutonymphs of this mite were found in crevices between the more strongly chitinised parts of the body. Females and eggs of a Tarsonemid of the genus *Podapolipus* were also found on the same stock of locusts, but occurred only on the underside of the wing-bases. Brief notes on the mites parasitic on Acridids are appended, and important corrections are made in the treatment of these parasites in Uvarov's book on locusts and grasshoppers [*R.A.E.*, A **17** 2].

UVAROV (B. P.). **El problema de la langosta.** [The Locust Problem.] —*Ciencia* **1** no. 8 pp. 337–342, 1 fig., 12 refs. Mexico, D.F., 1940.

A brief summary is given of the theory of locust phases and its practical application [*R.A.E.*, A **26** 677 ; **28** 28], as well as of the organisation of locust research and plans for the prevention of outbreaks in the Old World [*cf.* **27** 475–486, etc.]. Recent data on *Schistocerca paranensis*, Burm., in Argentina [*cf.* **28** 60, 189, 215] show that this species also undergoes phase transformation, and further investigations should be directed to discovering its outbreak areas, with a view to adopting a preventive policy. The establishment of an international organisation for locust investigations covering the whole of South and Central America is urged.

WALOFF (Z. V.). **The Distribution and Migrations of** *Locusta* **in Europe.** —*Bull. ent. Res.* **31** pt. 3 pp. 211–246, 4 figs., 4 pp. refs. London, 1940.

From the biometrical study of specimens of *Locusta migratoria*, L., from different parts of Europe, and from a recapitulation of the history of invasions of Europe and the British Isles by this species, from the 14th century to the present day, it is concluded that the subspecies concerned was *migratoria* and that it originated in the West Pontian outbreak area, which formerly comprised the lower courses of the rivers draining into the Black Sea, from the Danube to the Dnieper, and is now restricted to the Danube delta. The invasion area of this subspecies used to include central Europe and the eastern part of the north European plain ; the northern part of the plain, the British Isles and Fenno-Scandia, which lie on the outskirts of the invasion area, were usually reached by small detachments from the swarms. The distances covered within a single generation by swarms of *L. m. migratoria* in temperate Europe were comparable in extent to those traversed by *L. m. migratorioides*, R. & F., in tropical Africa. The decline of the West Pontian outbreak area was accompanied by a gradual reduction of the area invaded by large swarms, though its original limits still continue to be reached by small groups of ph. *gregaria*.

Long-range migrations of this subspecies are not confined to ph. *gregaria* but occur also in ph. *solitaria*, as is shown by the arrival of this phase in the British Isles during the periods when the West Pontian

outbreak area is in a quiescent state. From this and similar findings with regard to migrations of ph. *solitaria* in *Schistocerca gregaria*, Forsk., and *L. migratoria* in India [*cf. R.A.E.*, A **25** 161 ; **27** 559] and in *Nomadacris septemfasciata*, Serv., in Africa [**27** 387], it is concluded that long-range migrations are a regular phenomenon in swarming Acridids, occurring independently of the presence of large numbers and of phase, and are probably determined by factors of seasonal meteorology, which have a similar effect on all the phases.

It is probable that females of *L. m. migratoria* that reach the British Isles sometimes oviposit there, but the eggs are apparently unable to survive winter conditions.

The western Mediterranean region, which is not subject to invasions from the West Pontian area, is inhabited by a race of *Locusta migratoria* intermediate in size between *L. m. migratoria* and *L. m. rossica*, Uv. & Zol., while relict colonies of *L. m. rossica* and of races closely allied to it are scattered over central and northern Europe and sometimes give rise to local outbreaks.

HANSON (H. S.). **The Prevention of Outbreaks of the Pine Beetles under War-time Conditions.**—*Bull. ent. Res.* **31** pt. 3 pp. 247–251. London, 1940.

Attention is drawn to the importance of the damage that can be caused if outbreaks of bark-beetles and weevils occur in the extensive areas that have been stocked with conifers during the past twenty years in Britain. The risk of such outbreaks is increased by excessive war-time felling, because they usually originate, not in the young plantations where the damage will be done, but in felled areas, sometimes several miles away. The life-cycle of *Myelophilus piniperda*, L., as it occurs in various parts of the country is outlined, with a note on that of *M. minor*, Htg., which is confined to parts of Scotland, and on the ways in which these beetles damage pines ; and, on the basis of this, it is shown that efficient organisation, ensuring correct co-ordination between felling, extraction and conversion, will prevent felling areas from becoming sources of infestation by them. An account is given of the measures required under normal conditions, and of the modifications necessary when the amount of timber is too great for it all to be dealt with during the optimum period, when it has to be supplied regularly to a central sawmill, and when pitwood operations are being carried out.

Further investigation is necessary for dealing effectively with the pine weevil, *Hylobius abietis*, L., but some check on its increase can be effected by barking the stumps while the larvae are between the bark and the wood. The time can be ascertained by examining one or two stumps at intervals, and the bark should be removed to a depth of several inches below ground level.

VESEY-FITZGERALD (D.). **The Control of Coccidae on Coconuts in Seychelles.**—*Bull. ent. Res.* **31** pt. 3 pp. 253–286, 2 pls., 7 refs. London, 1940.

The following is based largely on the author's summary. The investigation described was begun in 1936 and closed in 1939. Owing to the low returns from the cultivation of coconut in Seychelles, it was imperative that control measures should be cheap, and biological methods were therefore employed. The three types of soil on which

coconuts are planted are discussed. The robustness of the trees was found to depend directly on the quality of the soil. The coconuts are attacked by a complex of scale species. None of them presents major problems in other countries, and the better known scales that are pests on coconut elsewhere are not found in Seychelles. The most important species are *Chrysomphalus ficus*, Ashm., *Eucalymnatus tesselliatus*, Sign., *Ischnaspis longirostris*, Sign., and *Pinnaspis buxi*, Bch., of which the last two are recent introductions to the islands. The life-history and particular requirements of each species are given, and their incidence on coconut and their interspecific relationships are discussed. Of the four Coccinellids introduced against them from Tanganyika Territory [*cf. R.A.E.*, A **26** 433, 611; **27** 335; **28** 330], *Chilocorus distigma*, Klug, and *C. wahlbergi*, Muls., are predacious on Diaspine scales and *Exochomus ventralis*, Gerst., and *E. flavipes*, Thnb., on Lecaniines. Their life-histories and the methods adopted for breeding and establishing them are described. Records covering three years are given showing that they are reducing the scales below the density at which they cause economic loss and also supporting the view that the reduction of one species is not being followed by the increase of another.

TRÄGÅRDH (I.). **Second Survey of the Wood-destroying Insects in public Buildings in Sweden.** —*Bull. ent. Res.* **31** pt. 3 pp. 287–294, 4 figs. London, 1940.

The results of investigations on wood-destroying insects in Götaland (southern Sweden) [*cf. R.A.E.*, A **23** 684; **26** 440] were confirmed by similar investigations in Svealand (central Sweden), where the same species occurred, but a rather smaller proportion of buildings was infested. *Hylotrupes bajulus*, L., which is the most important pest of timber in buildings in Sweden, and *Callidium violaceum*, L., occurred more frequently and *Ernobius mollis*, L., and *Anobium punctatum*, DeG. (*striatum*, Ol.) equally and less frequently, respectively, than in Götaland. As before, intensity of infestation was greater on the coast than inland and appeared to be correlated with population. In both provinces, roof timbers were more exposed to attack by *Anobium* and *Hylotrupes*, of which the former was more common, than other parts of the buildings. The liability to infestation by these pests appeared to increase with the age of the house up to 40–70 years, after which it was constant, and infestation was more severe under iron or tar-paper roofs than under tiles; houses with roofs of shingle were most commonly attacked. In a supplementary investigation in Stockholm, 195 of 340 houses were infested; no attack was recorded in houses less than 25 years old, attacks were in the initial stages in houses 25–50 years old, and infestation remained approximately constant in intensity in those more than 75 years old.

Brief notes are given on the geographical distribution of *H. bajulus* in Sweden [*cf.* **26** 155] and on the biology of the different species, with special reference to its influence on dissemination [*cf.* **23** 683].

PHILLIPS (J. S.). **Immature Nutfall of Coconuts in the Solomon Islands.**—*Bull. ent. Res.* **31** pt. 3 pp. 295–316, 1 pl., 4 figs., 22 refs. London, 1940.

Previous work in the Solomon Islands on the factor or factors responsible for the fall of immature nuts, which causes a great reduction

in the yield of coconut palms, is reviewed [*cf. R.A.E.*, A **17** 416; **23** 280, 634; **24** 328, 568, etc.], and experiments and observations made in 1935–39, chiefly on *Amblypelta cocophaga*, China, are described. An account is given of the life-history of this Coreid in the plantations, its food-plants and distribution and the injury it causes. The life-cycle lasted 37–38 days in the laboratory.

The following is based on the author's conclusions. *A. cocophaga* is the main agent responsible for immature nutfall. It probably came from the bush, and the area of invaded plantations is slowly increasing. An observed population of less than two bugs per tree is sufficient to render an area non-bearing. Of the fallen nuts found in "nutfall" areas, 97 per cent. show the typical signs of injury due to *Amblypelta*. About 90 per cent. of the nuts fall before they are six weeks old. As this Coreid can successfully attack nuts up to at least 16 weeks old, and as it may be found on parts of the palm other than the spadices and also on various plants in the undergrowth of the plantations, any form of mechanical or chemical control is likely to be ineffective and certain to be far too expensive. Thus, biological control is the only measure possible. Local natural enemies include three egg-parasites, one of which is a species of *Anastatus* [*cf.* **24** 569], a predacious Reduviid, *Euagoras dorycus*, Boisd., which attacks the nymphs and adults, and four ants, in addition to an entomogenous fungus. All these seem to be comparatively ineffective except *Oecophylla smaragdina*, F., and *Anoplolepis longipes*, Jerd., which give almost complete control on the palms on which they occur. These, however, are being slowly driven out of the plantations by *Pheidole oceanica*, Mayr, and *Iridomyrmex myrmecodiae*, Emery, which are unable to control *Amblypelta*, and the spread of nutfall proceeds as the beneficial ants are ousted by the intruding species.

Manis (H. C.) & Leffert (I.). **Preliminary Studies on the comparative Value of some Sprays and Dusts in Potato Insect Control.**—*Iowa St. Coll. J. Sci.* **14** no. 2 pp. 155–161, 3 figs., 10 refs. Ames, Iowa, 1940.

During the summer of 1938, spraying and dusting experiments were carried out in Iowa against potato insects, chiefly *Empoasca fabae*, Harr., in an attempt to find a substitute for Bordeaux mixture with an arsenical. The experimental technique is described. The treatments compared with a spray of Bordeaux mixture (4 : 4 : 50) containing 1 lb. Paris green per 50 U.S. gals. were dusts of sulphur alone, 1 lb. Paris green mixed with 10 lb. sulphur or 10 lb. talc, and 1 lb. derris (4 per cent. rotenone) with 2 lb. talc, and sprays of 6 lb. hydrated lime in 50 U.S. gals. water, and 2 lb. hydrated lime and 1 lb. Paris green, also in 50 U.S. gals. water. The hydrated lime used was one of high calcium content. The sprays were applied to the lower surfaces of the leaves at 120–150 lb. pressure and at the rate of approximately 100 U.S. gals. per acre, and the dusts were applied at the rate of approximately 60 lb. per acre. Each plot received 4 applications at intervals of 10–12 days between 8th July and 12th August. To eliminate differences in yield due to damage by *Leptinotarsa decemlineata*, Say, all plots were sprayed with Paris green and lime on 2nd July. The effectiveness of each treatment was determined by counts of adults

and nymphs of the Jassid and the amount of hopperburn, and tuber yields were compared at the end of the season.

Sulphur dust and the spray of Bordeaux mixture and Paris green effectively reduced the numbers of leafhoppers and the damage due to them and resulted in the highest average yields (157·8 and 150·4 lb. per plot), which were significantly higher than those from any other plots except those treated with derris. The dust of sulphur and Paris green was equally effective in reducing leafhopper populations and damage, but the yield (135·6 lb.) was reduced, possibly by some harmful action of the Paris green on the plants. Plots treated with Paris green and talc showed a pronounced reduction in the numbers of *E. fabae*, but the amount of damage to the plants was higher than on any of the other plots owing to scorching by the arsenical. The yield on these plots (105 lb.) was significantly lower than on any of the others. Plots sprayed with Paris green and lime showed little if any reduction in leafhopper populations. Damage was high and the yield was 128·4 lb. The dust of derris and talc was not consistent in its reduction of the numbers of leafhoppers ; damage by them was relatively high, but the yield was also high (137·4 lb.). Plots sprayed with hydrated lime gave results somewhat similar to those obtained on plots dusted with derris ; the yield (124·7 lb.) was lower, but the difference was not significant.

Decker (G. C.) & Drake (C. J.). **Preliminary Studies on the Use of Dinitro-o-cresol Dusts in Grasshopper Control.**—*Iowa St. Coll. J. Sci.* **14** no. 4 pp. 345–351, 8 refs. Ames, Iowa, 1940.

Laboratory experiments were carried out in Iowa on adults of *Melanoplus bivittatus*, Say, with 24 different contact poisons, mostly nitrophenols and allied compounds. These were tested as dusts into which the grasshoppers were dipped. Those dipped in sodium-arsenite dust used for comparison died after 35 minutes, while those dipped in 3,5-dinitro-ortho-cresol or 2,4-dinitro-phenol died in 21–22 minutes. In all cases, males were killed more quickly than females, and only the latter were used in subsequent experiments. When mixed with diatomaceous earth in various proportions, dinitro-o-cresol gave the best results, and it was subjected to further tests in which a dusting atomiser was used. Grasshoppers that were thus treated with a 10 per cent. dust and were then placed on unpoisoned food all died in 2 and 96 hours when the rates of application were equivalent to 40 and 10 lb. per acre, respectively. Undusted grasshoppers placed on soy-bean plants dusted at the lower rate were all killed in 48 hours, which shows that dinitro-o-cresol acts as a stomach poison, as well as by contact. When grasshoppers and plants were dusted together, 100 per cent. mortality resulted in 24 hours. These data suggest the possibility of using a 10 per cent. dinitro-o-cresol dust, applied at the rate of 10–15 lb. per acre, for field control of grasshoppers. Rough field tests with adults of the Mormon cricket (*Anabrus simplex*, Hald.) showed that 20–25 lb. of 15 per cent. dust per acre was necessary to obtain 86–89 per cent. mortality, but the first-instar nymphs were killed in one hour by 5 per cent. dust at the rate of 4 lb. per acre, or 10 per cent. dust at the rate of 3 lb. Overwintered adults of the chinch bug (*Blissus leucopterus*, Say) were killed in an hour by 10, 5 and 2 per

cent. dust mixtures at rates of 2, 3 and 10 lb. per acre, respectively, but higher dosages would probably be required in actual field work.

Data on the effects of dinitro-o-cresol and related compounds on insects and plants are briefly reviewed, and it is suggested that until more is known about plant tolerance, the use of these compounds may be restricted mainly to the control of grasshoppers and other insects where scorching of plants is of secondary consideration. Since no data are available on their effect in small concentrations on man, they should be used in field experiments only with masks and protective clothing.

SPAIN (L. A.). **Some Reactions of Grasshoppers to Castor Bean Plants.** —*Iowa St. Coll. J. Sci.* **14** no. 4 pp. 353–356, 1 pl., 4 refs. Ames, Iowa, 1940.

Cage experiments carried out in Iowa on hoppers and adults of *Melanoplus differentialis*, Thos., *M. bivittatus*, Say, and *M. mexicanus*, Sauss., showed that castor plants [*Ricinus communis*] have no value in grasshopper control [*cf. R.A.E.*, A **28** 468]. When given a choice between cereals and light varieties of castor, grasshoppers fed on the former, but were not repelled by the latter and often rested on them. First-stage hoppers fed exclusively on castor plants lived on an average for 4·6 days ; older hoppers survived for about 30 days, but mortality was high. Half of the adults fed on castor plants were dead after 29 days.

GUNDERSON (H.). **Effect of Ether on the Toxicity of certain Fumigants to the Confused Flour Beetle, *Tribolium confusum* Duval.**—*Iowa St. Coll. J. Sci.* **14** no. 4 pp. 405–417, 7 figs., 31 refs. Ames, Iowa, 1940.

An account is given of experiments to determine the toxicity to adults of *Tribolium confusum*, Duv., of ether, carbon bisulphide, carbon tetrachloride and ethyl acetate at 30°C. [86°F.] and an exposure of two hours, and the effect of adding ether to the other three fumigants.

The test insects were reared under standard conditions and used when 2–6 weeks old. During the tests, none of the control insects died, so that natural mortality is apparently negligible within this age group. From 30 to 50 beetles, selected at random from a large group, were used in each experiment, and after fumigation they were placed on clean flour at 30°C. and examined at intervals of 24, 48 and 96 hours. The concentrations in mg. per litre required to give 50 and 99 per cent. mortality were 832 and 991 for ether, 115 and 178 for carbon bisulphide, 135 and 248 for carbon tetrachloride, and 108 and 148 for ethyl acetate. When sublethal concentrations of ether (about 33, 130 and 520 mg. per litre) were added to approximately median lethal concentrations of the other fumigants, the toxicities of the mixtures containing carbon bisulphide and carbon tetrachloride increased with all concentrations of ether, whereas the toxicity of ethyl acetate was reduced by the highest concentration, little affected by the intermediate one and increased by the lowest.

MATHERS (W. G.). **The Shot Hole Borer, *Anisandrus pyri* (Peck), in British Columbia (Coleoptera, Scolytidae).**—*Canad. Ent.* **72** no. 10 pp. 189–190, 8 refs. Guelph, 1940.

The Scolytid, *Xyleborus dispar*, F. (*Anisandrus pyri*, Peck), which has long been present in eastern Canada and the United States and also occurs in western coastal districts, has become increasingly injurious of recent years in British Columbia. It was first recorded there in 1922 (*R.A.E.*, A **10** 579), but evidence is given showing it to have been present some years previously. Records of its occurrence and local distribution in the Province are briefly reviewed. In addition to common fruit trees, it has attacked Japanese ornamental cherry, walnut (*Juglans*), plane (*Platanus*), maple (*Acer*), *Acacia*, weigela (*Diervilla*) and willow (*Salix*).

To ascertain the dates of emergence of the adults, a section of the trunk of a young plum tree that had been attacked in mid-April 1934 was kept under field conditions and enclosed by a cage from 25th April to 7th November 1934, and again from 15th February to 4th April 1935. In 1934, a few of the adults re-emerged in May, but the majority of the overwintered generation died in the egg tunnels. Adults of the new generation were present on 14th July, but none of them emerged from the tree until the spring of 1935. They began to emerge about the middle of March on clear warm days when the temperature in the cage rose well above 60°F. The weather was cool in late March, but further emergence took place in early April. Altogether, about 1,000 beetles were recovered from the caged sample, which consisted of less than 200 cu. ins. of wood, and the proportion of females to males was approximately 22 : 10. No natural enemies were observed.

PAPERS NOTICED BY TITLE ONLY.

WAINWRIGHT (C. J.). **The British Tachinidae (Diptera) : Second Supplement.**—*Trans. R. ent. Soc. Lond.* **90** pt. 14 pp. 411–448, 11 figs., 11 refs. London, 1940. [*Cf. R.A.E.*, A **16** 480; **21** 144.]

VAN DER VECHT (J.). **De kleine pepersnuitkever (*Lepianus piperis* Marsh.).** (*L. piperis* on *Piper nigrum* in Netherlands Indies.—*Meded. algem. Proefst. Landb.* no. 42, 44 pp., 7 figs., 19 refs.; also as *Meded. Inst. PlZiekt.* no. 97. Buitenzorg, 1940. (With a Summary in English.) [See *R.A.E.*, A **29** 32.]

BROWN (A. W. A.). **The Canadian Forest Insect Survey in 1939.**—*Rep. ent. Soc. Ont.* **70** (1939) pp. 95–114, 10 figs., 2 refs. Toronto [1940]. [*Cf. R.A.E.*, A **28** 514; **29** 36.]

TWINN (C. R.). **A Summary Statement in Regard to some of the more important Insect Pests in Canada in 1939.** *Rep. ent. Soc. Ont.* **70** (1939) pp. 115–125. Toronto [1940].

BODINE (J. H.) & ROBBIE (W. A.). **Physiological Characteristics of the Diapause Grasshopper Egg *Melanoplus differentialis*, Thos.). I. The Stability of the Diapause Condition.**—*Physiol. Zool.* **13** no. 4 pp. 391–397, 3 figs., 12 refs. Chicago, Ill., 1940.

JOHANNSEN (O. A.) & BUTT (F. H.). **Embryology of Insects and Myriapods.** —Med. 8vo, xi — 462 pp., 370 figs., 37 pp. refs. London: McGraw-Hill Pub. Co. Ltd., 1941. Price £1 15*s*.

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AGRICULTURAL JOURNAL, DEPARTMENT OF AGRICULTURE, BRITISH COLUMBIA (VICTORIA): Vol. I (1916), Nos. 1 and 2.

AGRICULTURAL NEWS (BARBADOS): Nos. 1, 25, 26, 34, 66 (1902–04).

ANNALS OF THE QUEENSLAND MUSEUM (BRISBANE): Nos. 1, 5 and 6 (1891–).

ANNUAIRE ET MÉMOIRES DU COMITÉ D'ETUDES HISTORIQUES ET SCIENTIFIQUES DE L'AFRIQUE OCCIDENTALE FRANÇAISE (GORÉE): Vols. I–II (1916–17).

ARCHIVES DE L'INSTITUT PASTEUR DE TUNIS:
1906–09; 1910, fasc. i–iii; 1911, fasc. iii–iv.

ARCHIV FÜR SCHIFFS- UND TROPEN-HYGIENE (LEIPZIG):
Bd. XVII (1913). Heft 9.

ARQUIVOS DO INSTITUTO BACTERIOLOGICO CAMARA PESTANA (LISBON):
Vols. I–II (1906–10). Vol. III No. 1 (1911).

THE BEE WORLD (BENSON, OXON): Vols. I–II (1919–21).

BIOLOGICAL BULLETIN OF THE MARINE BIOLOGICAL LABORATORY (WOODS HOLE, Mass.):
Vols. I–II (1899–1901); XXIII (1912); XXIV (1912) No. 2; XXV (1913) Nos. 5–6; XXVI (1914) Nos. 1–2; XXVII (1914) No. 4; XXVIII (1915) No. 1; XXIX (1915) No. 5; XXX (1916) Nos. 2–3; XXXI (1916) Nos. 4 & 6; XXXII–XXXIII (1917); XXXIV (1918) Nos. 1–4, & 6; XXXV (1918); XXXVI (1919) Nos. 2–3; XXXVII (1919) Nos. 4 & 6; XXXVIII (1920) Nos. 1, 2, 5 & 6; XXXIX (1920) Nos. 4–6; XL (1921) Nos. 1–4, & 6; XLI (1921) Nos. 2 & 3; XLII (1922) Nos. 1–3.

BOLETIN DE LA DIRECCION DE ESTUDIOS BIOLOGICAS (MEXICO):
Tomos I–II (1924–25).

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Bulletin agricole de l'Algérie—Tunisie—Maroc (Algiers) :
Année XX (1914). Nos. 7–9, 12–14 and Title-page.

Bulletin du Comité d'Etudes historiques et scientifiques de l'Afrique Occidentale Française (Paris) : Année 1919, No. 1.

California Agricultural Experiment Station (Berkeley, Cal.) :
Circulars 14 and 42 (1905–09).

Chacaras e Quintaes (São Paulo) : Indices to Vols. X, XI, XII, XIV and XLII, No. 3.

Comptes Rendus des Séances de l'Académie d'Agriculture de France (Paris) : Tome VIII (1922) No. 5.

Egatea, Revista da Escola de Engenharia de Porto Alegre, Brazil :
Vols. I–VI (1916–21) ; VII (1922) Nos. 1–5 ; VIII (1923) Nos. 2–5 ; IX (1924) Nos. 1, 4–6.

Entomologica Americana (Brooklyn, N.Y.) :
Vol. IV (1888) Title-page. Vol. V (1889), Nos. 6 & 8.

Entomologische Litteraturblätter (Berlin) : 6. Jahrg. (1906). Nos. 2 & 10.

Experiment Station Record (Washington, D.C.) : Vols. I–IV (1889–94).

Georgia State Board of Entomology (Atlanta) :
Bulletin : 2, 6, 22 and 28. Circular : 1 to 3, 12, 15 to 18 and 20.

India : Forest Research Institute (Dehra Dun) :
Forest Bulletin (Old Series) : Nos. 1–3.

Indian Medical Gazette (Calcutta):
Vol. L (1915) No. 10 : LI (1916) Nos. 1–7, 10 ; LII (1917) No. 7 and title-page & index ; LIII (1918) ; and LIV (1919) No. 2.

Indiana : Third Annual Report of the State Entomologist, 1909–10.

Journal of the Board of Agriculture of British Guiana (Demerara) Vol. III No. 1 (1909). Title pp. and Indices to Vols. I–II.

Journal of the South-Eastern Agricultural College (Wye, Kent) : Nos. 1–6, 8, 11–13 (1895–1904).

Kentucky Agricultural Experiment Station (Lexington, Ky.) :
Bulletin Nos. 21 (1889), 31 (1890), 47 (1893), 53 (1894), 74 (1898) and 91 (1901).

The Kenya and East African Medical Journal (Nairobi) : Vol. II Nos. 2–3 (1925).

Natuurhistorisch Maandblad (Maastricht) : Jaarg. I (1912) ; II (1913) Nos. 1–4, 6–9 ; V (1916) Nos. 3–4 ; VII (1918) Nos. 6–9 ; VIII (1919) No. 4.

New Jersey State Department of Agriculture (Trenton, N.J.) : Bulletin 2 ; Circular : 2, 12, 29 (1917–19).

New York State Museum (Albany, N.Y.) : Bulletin : 26 & 57 (1899–1902).

Ontario Entomological Society Report (Toronto) : 9th (1878).

Ormerod (E. A.). Observations of Injurious Insects and Common Farm Pests during the Years 1877 & 1878 (London, 1878–79).

Philippine Agriculturist and Forester (Manila) :
Vols. II Nos. 1-3 (1912) ; III Nos. 1, 2 (1914) ; IV No. 4 (1915).

Philippine Journal of Science (Manila) : Vol I (1906) No. 10.

Porto Rico Department of Agriculture, &c. (San Juan) :
Journal, Vol. I (1917) No. 3.

Psyche (Boston, Mass.) : Vols. XI (1904), XIII (1906), XVI (1909).

Records of the Egyptian Government School of Medicine (Cairo) : Vol. I.

Revista de Agricultura de Puerto Rico (San Juan) :
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Indices to Vol. VI–XVI.

Revista Chilena de Historia Natural (Santiago) : Año XIV (1910) Nos. 4–6 ; XV (1911) Nos. 1 and 3 to end ; XVI, XVIII, XXVI (1912, 1914, 1922).

Revista de Veterinaria e Zootechnia (Rio de Janeiro) :
Annos I–II (1911–12). Anno III (1913) Nos. 1 to 3, and 5.

La Revue de Phytopathologie appliquée (Paris) : Tome I Nos. 22–23 (April–May, 1914).

Rhodesia Agricultural Journal (Salisbury) :
Vol. I Nos. 1, 3–6 ; II Nos. 2–4 ; III Nos. 1, 2, 6 ; IV No. 4 ; V No. 4 (1903–08) ; VII (1909–10) Nos. 1 & 6 ; IX (1912) No. 5 ; X (1912) No. 1. Title pp. and indices to Vols. I–V, VII, VIII, X.

Sciencia Medica (Rio de Janeiro) : Anno 1 Nos. 2–3, 5–6 ; II Nos. 1–10, 12.

South London Entomological and Natural History Society :
Report, 1879–84.

Tennessee Agricultural Experiment Station (Knoxville) :
10th (1897), 12th (1899), and 16th (1903) Annual Reports.

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by the South Essex Recorders, Ltd., Ilford.

(979) Wt. P14/3703 1700 6/41 S.E.R. Ltd. Gp. 432.